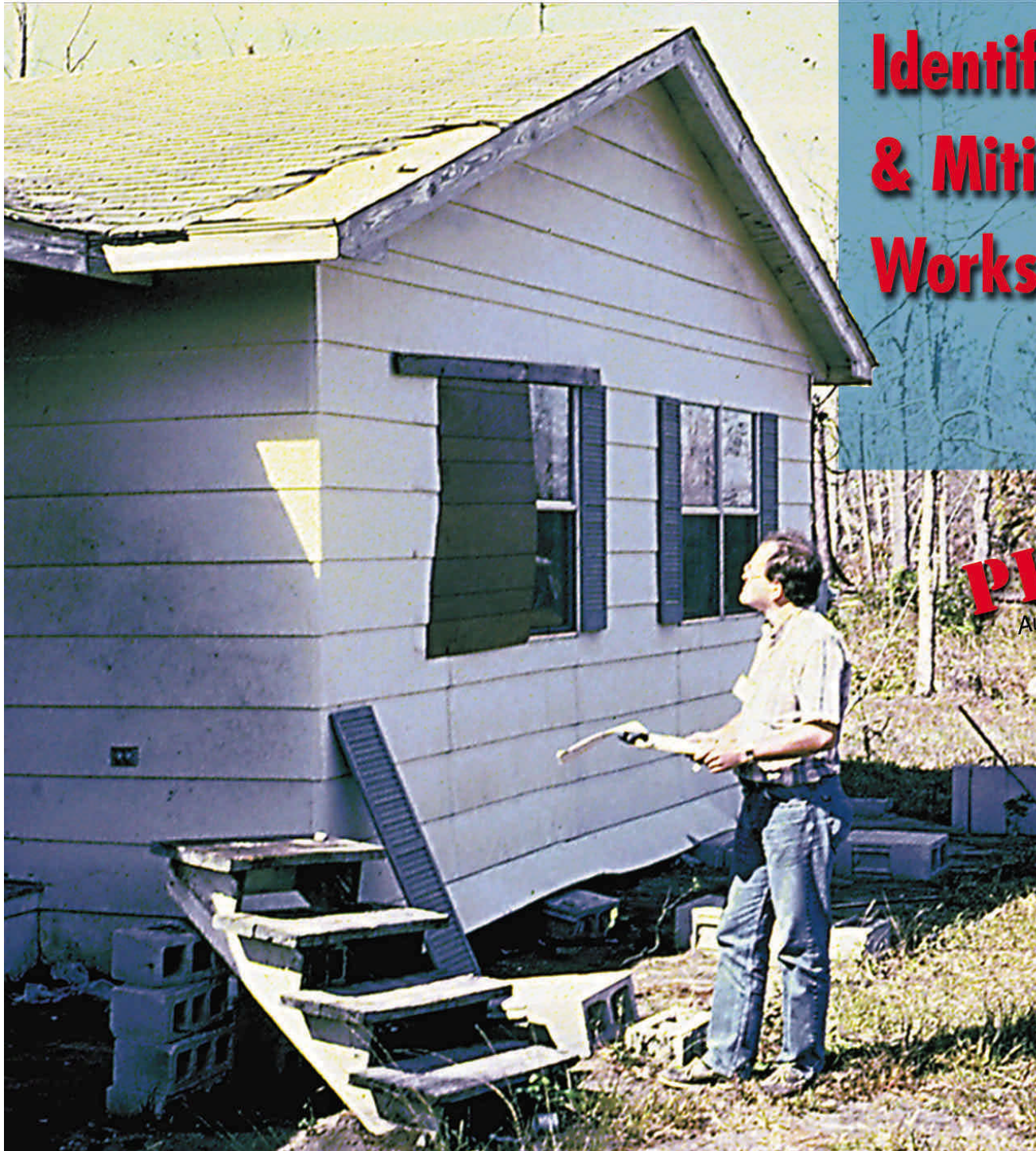




Hazard Identification & Mitigation Workshop

for the
**Weatherization
Assistance
Program**

PILOT
August 2000



PATH
PARTNERSHIP FOR ADVANCING TECHNOLOGY IN HOUSING



Hazard Identification and Mitigation Pilot Workshop

August 2000

Hazard Identification and Mitigation Workshop Manual

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Hazard Identification and Mitigation (HI&M) Training

**Recommended Total
Time: 30 minutes**

Introduction to the Course

Welcome and Introductions	The Facilitator performs a self-introduction and welcomes and introduces Guests. Participants introduce themselves by giving their names and describing their background in the Weatherization Assistance Program (WAP).
Course Purpose and Goal	<p>The course will provide a consistent approach to conveying information about natural hazard identification, assessment, and mitigation to State Energy Monitors and Community Action Group (CAG) inspectors. It is designed to integrate the activities of State and Federal agencies and enhance the delivery of federal, state and local services to citizens.</p> <p>Inspectors will be able to maximize the effectiveness of program resources for the homes of targeted low-income community members who have qualified and been chosen to participate in the Department of Energy – Federal Emergency Management Agency programs for Weatherization Assistance and Hazard Identification and Mitigation.</p>
Course Objectives	<p>After completing the course, you will be able to:</p> <ul style="list-style-type: none">• Determine the relative risks from flood, wind, earthquake and fire to your locality• Recognize the risks in the home being inspected• Determine appropriate mitigation measures to assist targeted low-income community members to:<ul style="list-style-type: none">- Reduce the potential risks associated with natural hazard events to their safety, health and homes,- Lessen their inconvenience and costs from damage• Use the resources of this program, the WAP and other sources to implement the appropriate mitigation measures• Maximize the benefits to the homeowner from all associated programs

Unit 1: Introduction

The Purpose of the Hazard Identification and Mitigation Training

The costs of providing federal assistance to communities after natural disasters have been very high. Many residents have been displaced from their homes and experience major disruptions to their lives as well as high costs and inconvenience while their homes are being repaired.

To meet the need to reduce these losses of life and property and reduce the inconveniences to affected homeowners, FEMA and DOE have instituted this Hazard Identification and Mitigation (HI&M) training initiative. It is a proactive effort before a disaster to assist residents by identifying the hazards that threaten them and their property.

The training will enable you to identify a home's particular risks and effective mitigation measures. You will also receive educational materials for residents to encourage them to take an active role in continuing to protect their homes.

- This Workshop Manual is designed to be a self-contained instructor and participant guide, aimed at State energy representatives and weatherization inspectors.
- The material contained in this manual, particularly the exercises and concept development, is most effective in a one-day, facilitated workshop. This should be combined with "on-the-job" follow-up training.
- The manual, provided in paper and electronic copy, should be customized for delivery by concentrating on local hazards, examples and applications.

Integration of the DOE Weatherization Assistance Program and the Hazard Identification and Mitigation Training

Many agencies are concerned with meeting the needs of citizens to improve their dwellings, their quality of life and reduce overall federal expenditures. In this instance, FEMA is working with the DOE, whose Weatherization Assistance Program provides services to targeted low-income residents to improve the energy efficiency of their homes.

Using the same person, trained and knowledgeable about both programs, to inspect a home and determine the most appropriate weatherization and mitigation measures maximizes the effectiveness of resources.

This training manual uses worked examples in each unit and two complete case studies to illustrate the application of the training to the inspection process.

The Critical Steps

In this course, you will practice using the following Critical Steps to implement the HI&M program as effectively as possible.

The critical steps for figuring out which mitigation measures to recommend for a particular home are:

1. Identify the relative risks to your locality for each natural hazard. (Tools are available from FEMA, such as a Flood Insurance Rate Map (FIRM) for flooding, the American Society of Civil Engineers for wind risk; the United States Geological Survey (USGS) for maps for earthquake risk, and the National Wildland/Urban Interface Fire Protection Program for a Peak Fire Seasons map.)
 2. Focus your assessment on the hazards that offer the highest relative risks to your area.
 3. Identify appropriate mitigation measures for the home you are inspecting. Mark all your identified mitigation measures on the Action Checklist.
 4. Consider the possibility of using other funds and programs to supplement this program.
 5. Use the Cost Sheet to determine the cost of implementing the mitigation measures.
 6. To maximize the benefit from a given mitigation measure you should consider the effect of the WAP and other programs on your choices.
 7. Decide which measures on the Action Checklist have the greatest effectiveness.
 8. Talk to the homeowner. As you leave, express your thanks for allowing your visit.
- If a recommendation is being made for the weatherization program there may be a good opportunity to combine with a mitigation measure

The following agenda shows exactly how we will proceed, unit by unit, to achieve the objectives.

Agenda and Timeframes

Time	Unit Content
8:00 – 8:30	Unit 1: Introduction <ul style="list-style-type: none">A. Introduction of Guests, Facilitator and ParticipantsB. Presentation of Course ObjectivesC. Discussion of the purpose of the Hazard Identification and Mitigation ProgramD. Integration of the DOE Weatherization Assistance Program and FEMA’s Hazard Identification and Mitigation Initiatives; Other Programs
8:30 – 9:30	Unit 2: Identify the Hazards <ul style="list-style-type: none">A. Flood: How to Determine Flood Hazard – Read a Flood Insurance Rate Map (FIRM), National Flood Insurance ProgramB. Wind: How to Determine Wind Risk – Read a Wind Zone MapC. Earthquake: How to Determine Earthquake Risk – Read a Earthquake Zone MapD. Fire: How to Determine Fire Risk – Read a Fire Risk MapE. Determine the Greater Relative Risks for Your Area
9:30 – 9:45	Break
9:45 – 2:15	Unit 3: Recognize the Risks and Mitigation Measures <p>Use the Action Checklist and Fact Sheets for:</p>
9:45 – 10:45	A. Flood Hazard
10:45– 11:30	B. Wind Hazard

Unit 1: Introduction

11:30-11:45	Break
11:45 – 12:30	C. Earthquake Hazard
12:30 – 1:30	Lunch
1:30 – 2:15	D. Fire Hazard
2:15 – 4:45	Unit 4: Integrate Costs, Relative Benefits and the WAP
2:15 – 2:25	A. Overview of Unit 4
2:25 – 2:55	B. Determine Costs
2:55 – 3:10	Break
3:10 – 3:40	C. Integrate the WAP Recommendations and Consider Overall Cost Benefits
3:40– 3:50	D. Make Final Decision
3:50 – 4:10	Break
4:10 – 4:25	E. Final Exercise
4:25 – 4:35	F. Discussion of the Final Exercise
4:35 – 4:45	Unit 5: Appendix
4:45 – 5:00	Course Evaluation

**Recommended
Time: 60-75 min.**

Determine Relative Risks of Natural Hazards

The Importance of Determining the Relative Risks of Potential Natural Disasters in Your Area

Because the amount of money available for assisting targeted homeowners is limited, it is critical to put those funds to the best use. Therefore, you need to assess first what are the greatest potential risks with the most severe consequences for your area and then the greatest potential risks for each home that will be inspected.

Although your area may be at risk for all four kinds of disasters: flood, wind, earthquake and fire, the possibility of the occurrence of one kind of disaster may be greater than for another. The consequences associated with each may also vary. Maps from FEMA and other sources are available to show the risks of each kind of disaster. Because some risk maps are general and use national data, you also need to focus as much as possible on the information available for your locality. For example, the national Wind Zone Map uses data for 1000 square miles, but Flood Insurance Rate Maps (FIRM) which show specific roads, tributaries and creeks are available for most localities.

To determine the relative risks of the various kinds of natural disasters, start by looking at maps that show the risk of each disaster to your area. In general, the darker the shading on the maps we are using for flood, wind, and fire, the greater the risk.

30-45 minutes

How to Determine Flood Risk using a Flood Insurance Rate Map

Because flooding is the most common disaster in the United States, is so disruptive to the lives of those affected, and repairs are so expensive both to those directly affected and the taxpayers, it is a major national concern. In fact, on an annual basis, floods cause ninety percent of all property losses from natural disasters in the United States. To enable homeowners to assess and manage their flood risks, FEMA has prepared detailed Flood Insurance Rate Maps (FIRMs) for many areas of the country. The agency has also instituted the National Flood Insurance Program which can speed homeowners' recovery from flooding by making insurance coverage available at very favorable rates. You can order FIRMs from FEMA or contact the local community's map repository. The map repository is usually located in the local City engineers or planners office. FEMA also provides a guide about how to use a FIRM.

Go to the back of the manual to a plastic pouch holding *How to Use a Flood Map To Determine Flood Risk For a Property*.

Lead the class through a review of the booklet and focus on key information on the left.

Pages for attention:

Inside cover: Message from the Director

P. 1: Table of Contents

P. 2: "National Flood Insurance Program"

Its purposes include reducing losses and discouraging unwise development and providing the public the opportunity to buy flood insurance from agents at private insurance companies. The program also encourages using sound building techniques to reduce potential future damage.

"What You Will Find on Flood Maps"

Middle column:

- Discussion of a 100-year flood

A 100-year flood means that for any year, the risk of a flood reaching or exceeding this level is 1%.

In practice, a 100-year flood means that in every year, the resident's risk of that level of flooding is the same.

Unit 2: Identify the Hazards

This level of risk does **not** mean that because a flood reached that point last year that the area is safe for the next 99 years, although that is what many residents think it means.

Therefore, before their home is actually flooded, many residents think they do not need to buy flood insurance. However, flood insurance is a cost-effective means of mitigating flood risk and is underwritten by the Federal government. Homeowners can purchase flood insurance by contacting their insurance agent or FEMA.

- Definition of Base Flood Elevation (BFE)
Base Flood Elevation refers to the predicted water level for the 100-year flood.

Column 3:

“What Flood Maps Can Help You Do”

“How to Obtain Flood Maps”

P. 4: Col. 1:

Paragraph 2 – Flood Maps are produced at different scales and cover different sized areas, i.e., entire counties, etc. or just parts of them. “Two Basic Formats”: Flat and Z-fold; “The Legend/Key to Map”

Column 2:

“The Index”

“The Panel”

“The Legend/Key to Map”

Column 3:

“The Title Box”

P. 5-6: “How To Read the Flood Map Index”

P. 7: Look at the examples.

P. 8: Col. 1: “Found on All Panels...”

Base (100-Year) Flood Elevation Line and Label:

A wavy line is used when the elevation varies along a watercourse. A label indicates the elevation is uniform across a large area. The elevation is usually expressed in feet, but may be in meters. (The default is in feet.)

Unit 2: Identify the Hazards

Col. 2, middle section:

Coastal Barrier Symbol

Note: For newer Z-fold Flood Maps, Zone X can be tinted or untinted. P. 13 and 14 explain that when shaded, Zone X indicates areas subject to a 500-year flood and a 100-year flood with depths up to one foot or a protected area. Untinted means the risk for that area is undetermined, and it is outside the 500-year floodplain.

P. 14:

Note states that this map “does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.”

Verify Understanding

P. 9:

Maps

Note differences between lighter and darker tinting.

On this page the difference is clear; however, when you have only one map with consistent shading, the difference may be less apparent.

Ask:

1. What does darker shading indicate?
2. On the top map, what do the numbers in the middle of the blocks mean?

P. 10-11:

- Determine what various useful map markings indicate by referring to the information on P. 12-14.

Note:

P. 14 The Legend is most comprehensive

P. 12 has definitions; there are more in the Glossary on P. 21.

P. 13 has more detail about what the codes indicate about the flood areas. Some of that information is also on P. 14.

- Although Zones C and X unshaded are outside the 500-year floodplain, the hazard beyond the 500 years is undetermined, so there is still potential hazard of flooding.

Unit 2: Identify the Hazards

The instructor should note that the FIRM shows the hazard due to flooding and the elevation of the 100-year flood. However, the depth of flooding in the structure determines the risk at an individual structure.

- Similarly, Zone D, which is unshaded, has undetermined flood hazards.
- Because the FIRMs do not show the contours of the land, you must look at the site where the home is located to assess its risk.

For example, if the land just outside the marked floodplain area is flat, the overflow water from a flood could easily flow to the site. However, if the home is situated on a rise, its risk is lowered.

Identify on P. 10-11:

3. The meaning of the numbers “8, 9, and 10” beside the wavy lines
4. The areas:
 - A. Of greatest hazard
 - B. Of less hazard
 - C. Of minimal hazard
 - D. Of unknown hazard
5. The meaning of the hatched lines in the Hackberry Draw and the consequences for a resident whose home is there
6. The hazard to Zone X areas at the top left which are untinted vs. those also in Zone X which are tinted
7. A Coastal Barrier area
8. The hazard associated with the area left of the marked “Limit of Floodway”

Explanation of how to determine the risk to a specific property.

P. 16-19
Follow the steps indicated.

It should be noted that the FIRM provides the relative hazard due to

Unit 2: Identify the Hazards

flooding. The depth of flooding in the structure determines the exact risk to a specific property.

Verify Understanding

Ask:

9. How do you get a FIRM?
10. Is a FIRM free?
11. If you want flood hazard information for a large city or county, how many maps will you need? How can you find out?

Use actual FIRM materials.
In the back of the manual, get the FIRM Map Index from the second plastic pouch.

Discuss:

12. What is the date of the map's information?
13. What does the 6-digit number "370168" signify?
14. What do the numbers after that 6-digit number signify?
15. What number do you need for the map showing Routes 40 and 17, the Murrayville and Kings Grant Tributaries and Pages Creek?

Get the detailed FIRM map from the back of the manual.

16. What is its date?
17. Is flood insurance available for residents in this area?
18. Find Murrayville Road at the left edge (middle) of the map. If there are any homes on that road in the floodplain, are some at greater risk than others?
19. Find location 1 on the map. What is its hazard?
20. What about the hazard for location 2?
21. What is the hazard for location 3, in the upper middle section of the map, in Zone C, far from marked flood zones? Can you safely assume that site is safe from flooding?
22. What is the hazard for location 9? Because the surrounding areas are designated Zone A10, EL 11, can you assume

Unit 2: Identify the Hazards

location 9 is fairly safe because it is marked Zone C?

(To save time, omit questions 23-26.)

Discuss the relative hazards for other marked sites:

23. Location 5

24. Location 7

25. Location 8

26. Location 10

Ask for questions.

Respond to questions.

The National Flood Insurance Program Fact Sheet

The National Flood Insurance Program

Refer to the National Flood Insurance Program Fact Sheet at the front of the Appendix. It tells what the program is, its purpose, what it covers, types of coverage offered, how to buy it, and some myths and facts.

Discuss Wind Risk
Time: 10 min.

How to Determine Wind Risk from a Wind Zone Map

Wind damage comes from the high winds often generated by a tornado or hurricane. Most of the central and eastern sections of the United States have some tornado risk; however, in the West, the risk from tornadoes is low. Maps that show that the combined risks from both tornadoes and hurricanes put most of central and eastern United States at medium to high risk for wind damage.

Directions for Using a
Wind Zone Map

Refer to the Wind Zone Map on page 2-15.

To determine wind risk to a particular area:

1. After locating your targeted area on the FEMA/Texas Tech University map, note its color and the significance of the color.
 - White – low risk area
 - Yellow – low medium risk area
 - Orange – medium high risk area
 - Brick – high risk area
2. Note the special markings noted in the Legend.
 - Hatching - a special wind region
 - Dots - a hurricane-susceptible region
3. Determine what mitigation measures are appropriate for the various levels of risk.
 - Low risk: the need for a high-wind shelter is a matter of preference.
 - Moderate risk: consider using a shelter for protection.
 - High risk: shelter is the preferred mitigation measure for protection.

For example:

- Detroit is in a brick area, so its risk is high. It is recommended that residents have a shelter for protection.

Unit 2: Identify the Hazards

Ask:

4. What effect does the hatching have on the orange section in western Virginia and North Carolina?

Verify Understanding

Ask:

5. What is the wind risk in Tulsa, OK?

Look on page 2-19 where you will find a Relative Risk Levels Table. Enter your answers to these questions.

6. What is the wind risk in Kansas City, MO?
7. What is the wind risk in Oakland, CA
8. What is the wind risk in Wilmington, NC?

Earthquake Risk
Time: 10 min.

How to Determine Earthquake Risk from an Earthquake Zone Map

When the ground shifts due to an earthquake, depending on the magnitude of the earthquake and the condition of buildings there may be damage to the contents of a home and its structure.

Directions for
earthquake map

Look at the Earthquake Zone Map on page 2-16.

To determine earthquake risk to a particular area:

1. Find your targeted area on this US Geological Survey map, and note its color.
2. Consult the Legend to determine the risk level:
 - White and blue – low risk
 - Green, yellow and orange – moderate risk areas
 - Red – high risk areas
 - %g means percentage of gravity

The map depicts the peak ground acceleration that has a 10% chance of being exceeded in the next 50 years. This is a general map that provides an indication of risk. Local soil conditions may amplify an earthquake's intensity. If earthquake is your highest hazard, it is recommended that you use local maps when they are available.

Note: Peak ground acceleration is often applied in the development of building codes, and this map was created in part as a tool for land use planning and building design in areas subject to earthquake hazards.

For example:

The green and yellow indicate the earthquake risk in western Virginia and NC is medium. How to pinpoint the risk more precisely than on this map is explained below.

Verify
Understanding

Exercise: Determine Earthquake Risk in a Selected Area

Unit 2: Identify the Hazards

3. What is the earthquake risk in Tulsa, OK?
4. What is the earthquake risk in Kansas City, MO?
5. What is the earthquake risk in Oakland/San Francisco, CA?
6. What is the earthquake risk in Wilmington, NC?

Use a detailed map of Wilmington, NC with directions.

Look on page 2-17 for a detailed earthquake zone map of the Wilmington, NC area. This very precise Legend shows the Wilmington area in blue, which corresponds to 3, a low relative risk.

Ask for questions

Respond to questions.

Time: 5 min.

How to Determine Fire Risk in a Selected Area

Look at the Fire Zones Map on page 2-18. Local weather conditions will affect the immediate risk of wildfire. The map describes the general or typical fire risk experienced by areas of the country by month.

The colors indicate:

- Red – the highest risk
- Orange - high medium risk
- Yellow - low medium risk (assume half the risk of orange)
- Green - low risk

To simplify using the map, because orange is the predominant color, use the number of months for which risk is marked as an indicator of relative risk:

- 1-4 – low risk
- 5-8 – medium risk
- 9-12 – high risk

Verify Understanding

1. What is the fire risk in Tulsa, OK?
2. What is the fire risk in Kansas City, MO?
3. What is the fire risk in Oakland/San Francisco, CA?
4. What is the fire risk in Wilmington, NC?

Encourage additional questions and respond to them.

Summary of Learning: Unit 2

Time: 1 min.

This unit discussed:

- The need to recognize selected natural hazards so homeowners:
 - Become aware of their risks
 - Will welcome the opportunity to implement mitigation measures to protect their own lives and property as well as others'
- For particular areas of the country, how to assess the relative risks of selected natural hazards:
 - Flood, the most costly hazard in the United States
 - Wind
 - Earthquake
 - Fire
- To assess flood hazard, FEMA provides Flood Rate Insurance Maps (FIRMs) for many localities. Also, the National Flood Insurance Program (NFIP) provides low cost flood insurance via private insurance companies to homeowners to speed their recovery from damage.
- To assess wind risk, you can consult a map showing wind risk zones such as one consistent with ASCE 7-98.
- To assess earthquake risk, national and detailed maps for specific areas are available from USGS and may be available locally.
- Information about fire risk is available from the National Wildland/Urban Interface Fire Protection Program and the US Department of Agriculture Forest Service.

Prepare for Unit 3

Time: 1 min.

After determining which hazards have greatest risk for your area, you need to focus on identifying the specific risks for each home and their appropriate mitigation measures.

Unit 3 has information about the dangers and pictures of the terrible consequences of the four selected natural disasters. It also explains what mitigation measures for the identified hazards can be applied to homes.

Unit 2: Identify the Hazards

Fact Sheets
Time: 1 min.

Mitigation measures are explained on Fact Sheets for each of the four selected natural disasters. Each Fact Sheet focuses on one mitigation measure. It shows:

- A picture of the catastrophic damages that can result from failure to recognize and take appropriate action against that specific risk.
- A picture of the existing risk
- A picture or diagram of the mitigation measure properly applied

These Fact Sheets may be shown or given to a homeowner to assist you in explaining the problem in that home as well as how the proposed mitigation measure might look when it is installed.

Action Checklist

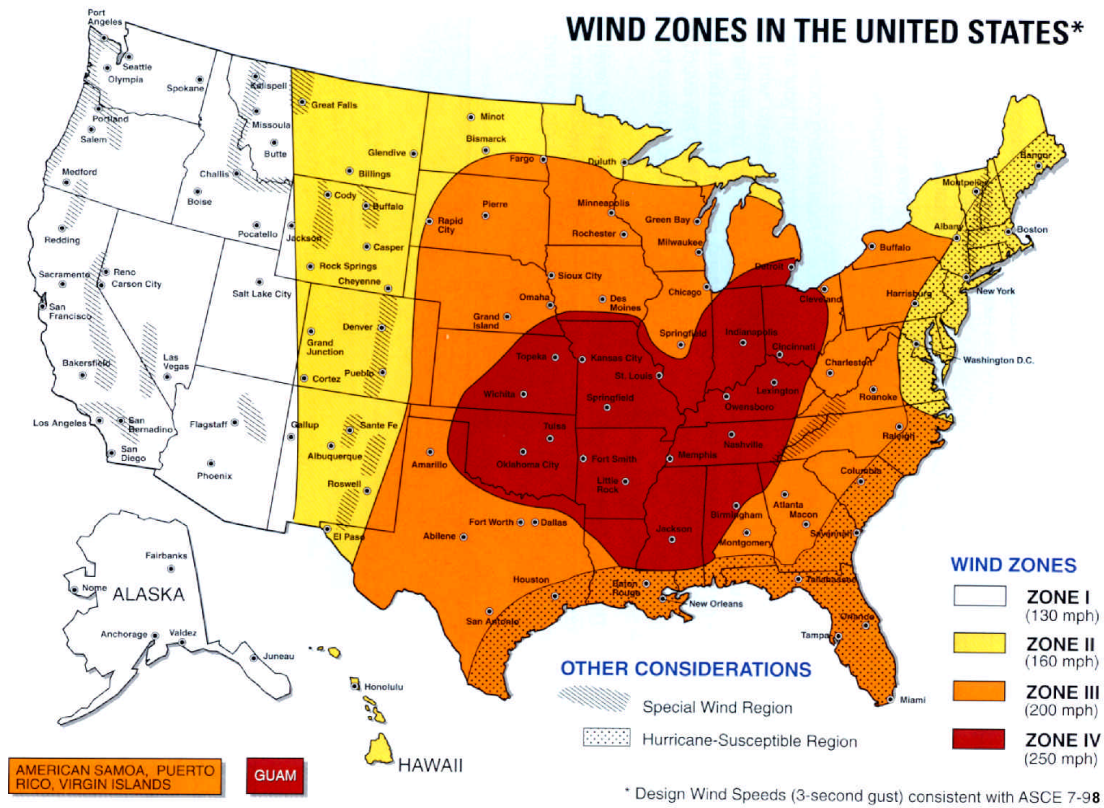
In Unit 3 you will also use a one page Action Checklist. It lists all the mitigation measures in approximately the same order as you need them – exterior, then interior, from the top to the bottom of the home. You can use it during the inspection to check all of the mitigation measures that apply to the home. Then you will consider which are the most beneficial ones to implement.

Questions

Respond to questions.

Unit 2: Identify the Hazards

Map of Wind Zones



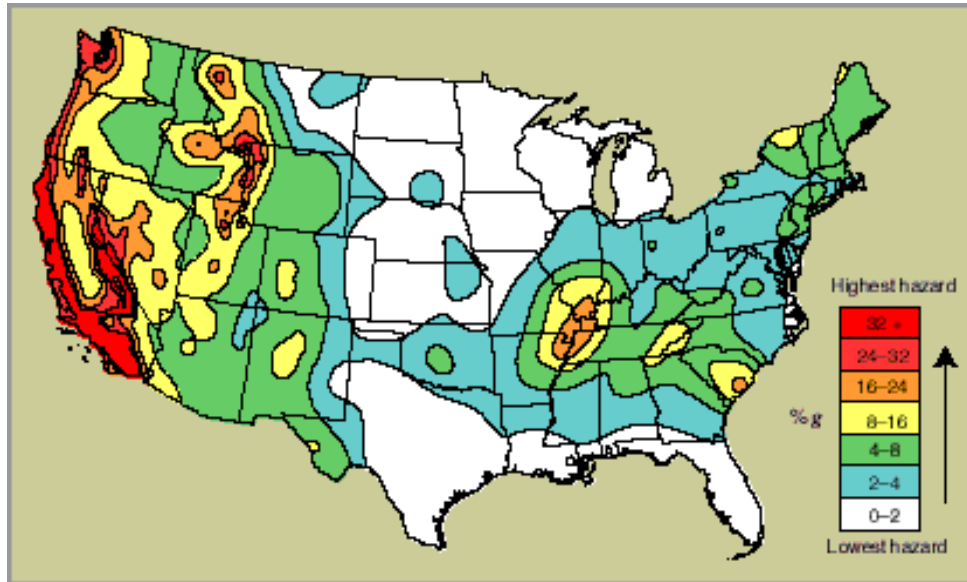
Unit 2: Identify the Hazards

National Map of Earthquake Zones

Note: Map taken from USGS website

National Seismic Hazard Mapping Project, August 2000.

<http://geohazards.cr.usgs.gov/eq/>



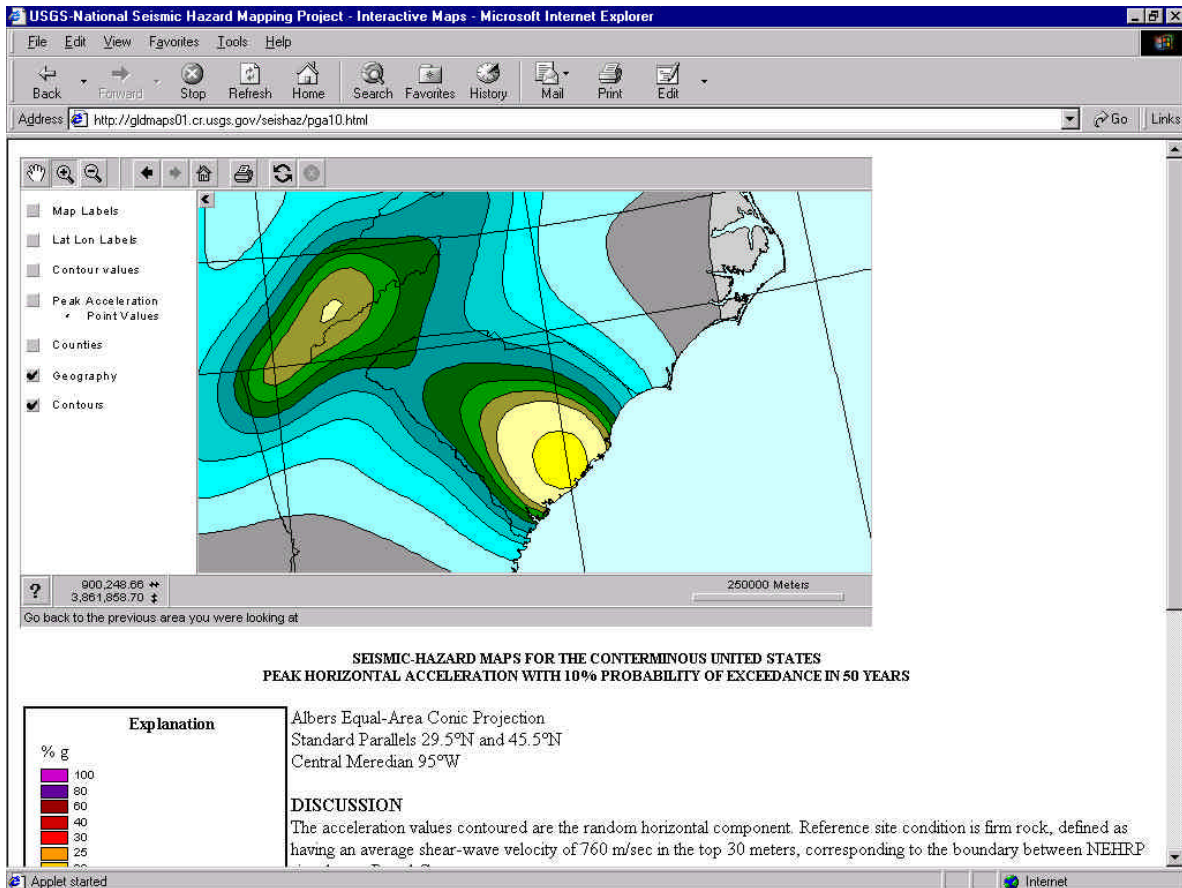
Unit 2: Identify the Hazards

Detailed Map of Earthquake Zones: Wilmington, NC

Note: Map taken from USGS website

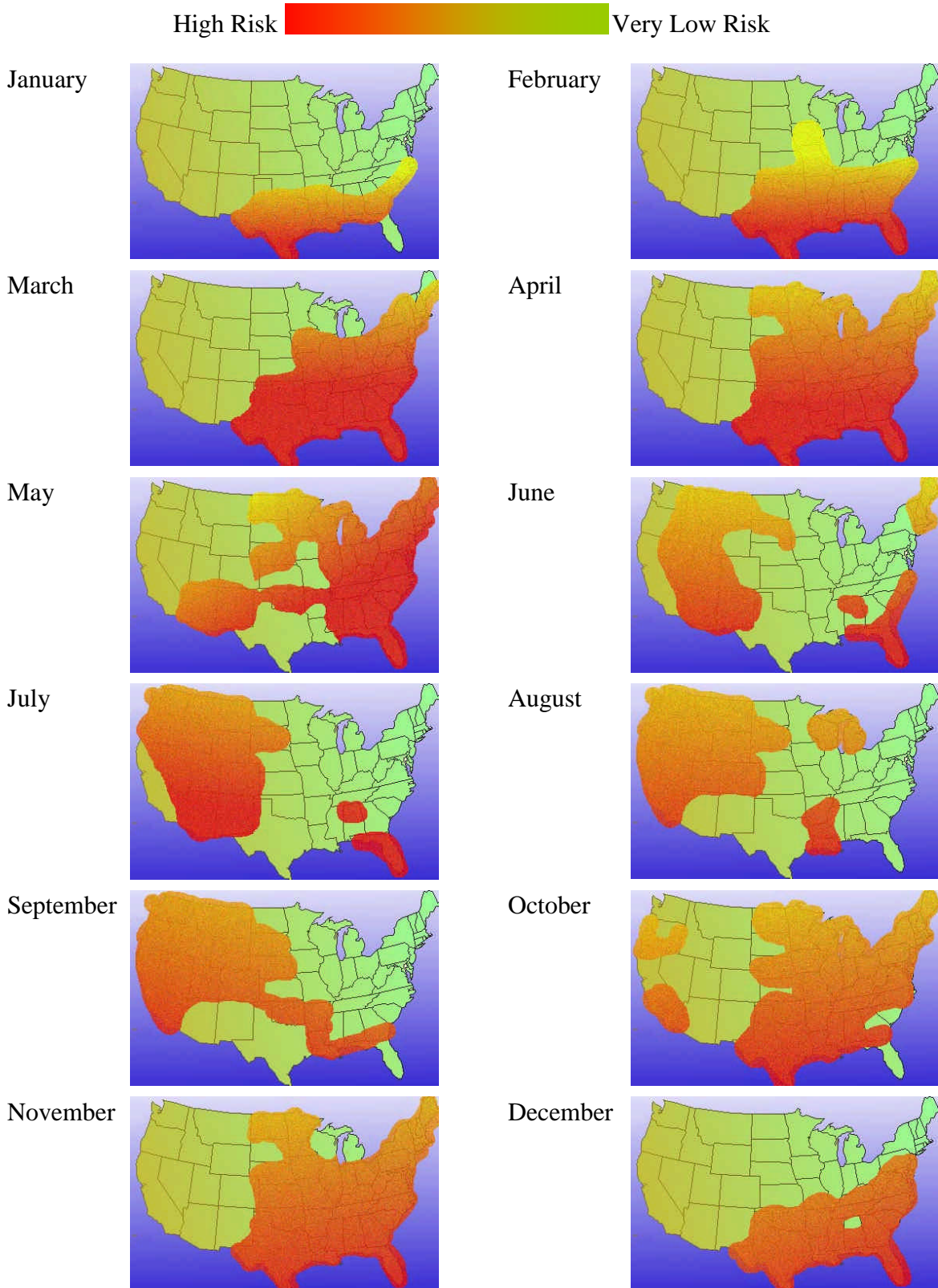
National Seismic Hazard Mapping Project, August 2000.

<http://gldmaps01.cr.usgs.gov/seishaz/pga10.html>



Unit 2: Identify the Hazards

Map of Fire Risk



Unit 2: Identify the Hazards

Relative Risk Levels from Selected Natural Disasters				
	Tulsa, OK	Kansas City, MO	San Francisco Oakland, CA	Wilmington, NC
Risk from:				
Flood*	Low	High	Low	Medium
Wind				
Earthquake				
Fire				

* Since the risk due to flooding varies from structure to structure and is determined by the depth of flooding in the structure, this information has been provided.

Unit 3: Recognize the Risks and Mitigation Measures

Notes

Recognize Specific Risks

Recommended Total Time: 3-4 hours

60 minutes for each hazard which includes 15 minutes for its Application Exercise

In this unit you will identify the specific risks for an individual homeowner and then consider which mitigation measures will be most beneficial. We'll discuss the Fact Sheets for the natural hazards; then you will see pictures of a home that has some mitigation opportunities for you to identify.

Use the Action Checklist

Use the Action Checklist after this page to assist you in this exercise and as a job aid in the field. It lists all four hazards and the mitigation measures by number. Those numbers correspond to the ones on the Fact Sheets.

Discuss Fact Sheets for Selected Hazards:

Discuss each Fact Sheet, which includes a discussion of the potential damage that can result from the risk and depicts the risk and the mitigation measure.

Flood
Wind
Earthquake
Fire

Guide a discussion of various pertinent points, such as:

- The relative benefits of these measures for various kinds of properties, including single family and manufactured homes
- Whether the measure is
 - Critical to protecting life, health and safety of people, ensuring the building integrity of the home, or
 - A desirable, but not essential change

Discuss the Fact Sheets for A Hazard

Refer to the following Fact Sheets, one at a time, for each hazard you wish to consider.

Verify Understanding

After discussing the mitigation measures for the hazard:

Ask for questions

- Do the Exercise at the end of the section for that hazard.

Unit 3: Recognize the Risks and Mitigation Measures

Action Checklists – Color and Black & White

(See next 2 pages)

Action Checklist


Name _____


Job # _____


Address _____


Date _____

Inspector _____

100.		FLOOD
101. Retrofit your well to reduce contamination <input type="checkbox"/>		106. Apply protective sealant to your walls <input type="checkbox"/>
102. Maintain storm drains on your property <input type="checkbox"/>		107. Install a septic backflow preventer <input type="checkbox"/>
103. Install a gas safety cut-off valve <input type="checkbox"/>		108. Consider wetproofing options <input type="checkbox"/>
104. Anchor and elevate fuel tanks & AC units <input type="checkbox"/>		109. Install interior or exterior flood walls <input type="checkbox"/>
105. Anchor your home <input type="checkbox"/>		110. Relocate or elevate internal appliances <input type="checkbox"/>

200.		WIND
201. Reduce potential for flying debris <input type="checkbox"/>		206. Fasten your roof & walls - hurricane straps <input type="checkbox"/>
202. Anchor the base of your manufactured home <input type="checkbox"/>		207. Improve the securing of your roof sheathing <input type="checkbox"/>
203. Bolt your house sill plate connection <input type="checkbox"/>		208. Improve closure of your windows and doors <input type="checkbox"/>
204. Increase your gable end bracing <input type="checkbox"/>		209. Create a safe area in your home <input type="checkbox"/>
205. Replace gable vent with slotted vent <input type="checkbox"/>		210. Improve the bracing of your "A" frame roof <input type="checkbox"/>

300.		EARTHQUAKE
301. Install a gas safety cut-off valve <input type="checkbox"/>		306. Use flexible connections for gas and water <input type="checkbox"/>
302. Brace your manufactured home <input type="checkbox"/>		307. Strap your water heater <input type="checkbox"/>
303. Bolt your house sill plate connection <input type="checkbox"/>		308. Secure your light home contents <input type="checkbox"/>
304. Brace your cripple walls <input type="checkbox"/>		309. Secure your furniture <input type="checkbox"/>
305. Brace your masonry chimney <input type="checkbox"/>		310. Improve the securing of your wall sheathing <input type="checkbox"/>

400.		FIRE
401. Create a firebreak around your property <input type="checkbox"/>		406. Install outside spigots <input type="checkbox"/>
402. Relocate or protect your exterior fuel tanks <input type="checkbox"/>		407. Install smoke & carbon monoxide detectors <input type="checkbox"/>
403. Maintain your gutters & clear roof of debris <input type="checkbox"/>		408. Provide fire extinguishers in your home <input type="checkbox"/>
404. Cover openings with fine mesh <input type="checkbox"/>		409. Install a spark arrester on your chimney <input type="checkbox"/>
405. Use fire resistant materials on your home <input type="checkbox"/>		410. Keep your chimney clean <input type="checkbox"/>

Notes: _____

Action Checklist

Name _____

Job # _____

Address _____

Date _____

Inspector _____

100.

- 101. Retrofit your well to reduce contamination ☐
- 102. Maintain storm drains on your property ☐
- 103. Install a gas safety cut-off valve ☐
- 104. Anchor and elevate fuel tanks & AC units ☐
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FLOOD

- 106. Apply protective sealant to your walls ☐
- 107. Install a septic backflow preventer ☐
- 108. Consider wetproofing options ☐
- 109. Install interior or exterior flood walls ☐
- 110. Relocate or elevate internal appliances ☐

200.

- 201. Reduce potential for flying debris ☐
- 202. Anchor the base of your manufactured home ☐
- 203. Bolt your house sill plate connection ☐
- 204. Increase your gable end bracing ☐
- 205. Replace gable vent with slotted vent ☐



WIND

- 206. Fasten your roof & walls - hurricane straps ☐
- 207. Improve the securing of your roof sheathing ☐
- 208. Improve closure of your windows and doors ☐
- 209. Create a safe area in your home ☐
- 210. Improve the bracing of your "A" frame roof ☐

300.

- 301. Install a gas safety cut-off valve ☐
- 302. Brace your manufactured home ☐
- 303. Bolt your house sill plate connection ☐
- 304. Brace your cripple walls ☐
- 305. Brace your masonry chimney ☐



EARTHQUAKE

- 306. Use flexible connections for gas and water ☐
- 307. Strap your water heater ☐
- 308. Secure your light home contents ☐
- 309. Secure your furniture ☐
- 310. Improve the securing of your wall sheathing ☐

400.

- 401. Create a firebreak around your property ☐
- 402. Relocate or protect your exterior fuel tanks ☐
- 403. Maintain your gutters & clear roof of debris ☐
- 404. Cover openings with fine mesh ☐
- 405. Use fire resistant materials on your home ☐



FIRE

- 406. Install outside spigots ☐
- 407. Install smoke & carbon monoxide detectors ☐
- 408. Provide fire extinguishers in your home ☐
- 409. Install a spark arrester on your chimney ☐
- 410. Keep your chimney clean ☐

Notes: _____

Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Measure Fact Sheets – Flood

(See following 10 pages)



Flood - 101

Retrofit your well to reduce contamination

Flooding is the most frequently occurring disaster in the United States. Most damage comes from river or ocean flooding, but it can also result from the flooding of small streams or creeks that rise quickly.

Flooding normally occurs in the same places. This predictability means you can focus on reducing damage there. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using mitigation opportunities. Now is the best time to floodproof your home and buy insurance under the National Flood Insurance Program.



Potential Hazard



Floodwater can rise so high that it could flow back into your well through the top, where you usually remove your water. Floodwater can be very dirty after it picks up dirt and silt. It can also be contaminated from oil and other very harmful pollutants from garages, houses, cars, farms and factories. These pollutants make the well water unsafe to drink. The cost of purifying the contaminated water or finding another source of safe drinking water may be very high. Also, if the well collar is poorly installed, floating debris will have a greater chance of damaging the well. The photo to the left shows an example of an unprotected well underneath a home. Many wells today have protective collars; even with a collar, your well may not be safe. The gaskets could be cracked from dry rot or old age.

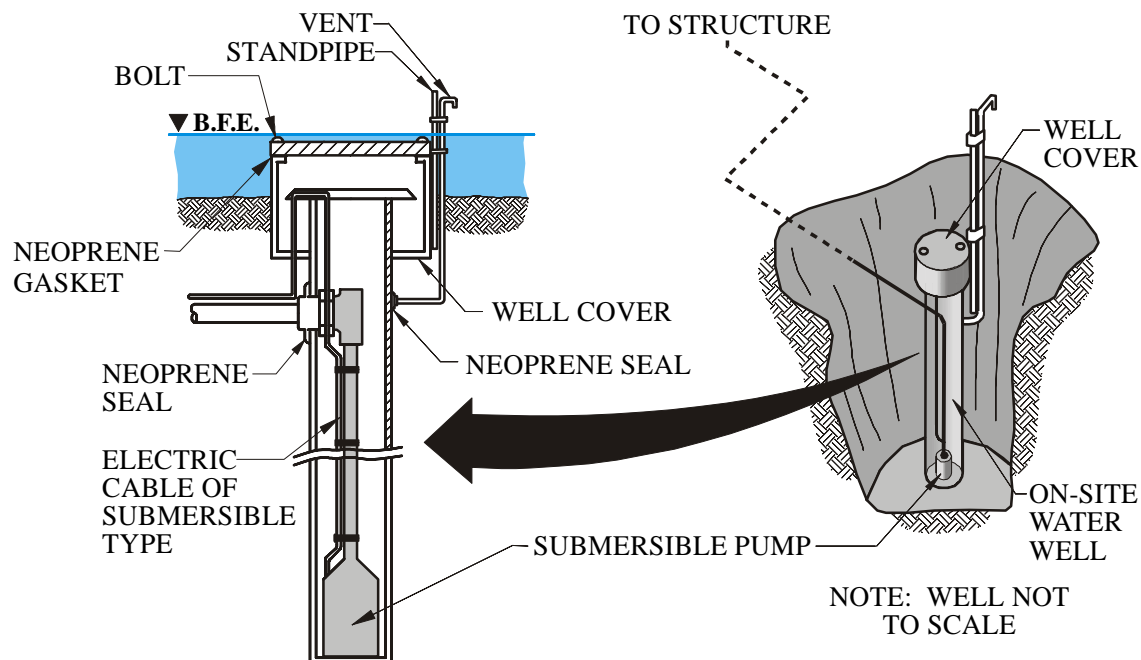
Mitigation Measure

To reduce the risks of floodwaters leaking into your well and contaminating its source, you can raise the protective collar around the well vault. The collar should be raised to 12" above the Base Flood Elevation. If this is impractical, you will have to rely upon a casing with a lid that has a gasket and bolts. A collar that you have to raise more than two and one half feet above ground level is impractical because it is too difficult to do any maintenance. If the floodwater velocity is low, there should be little chance of floating debris damaging the well casing. A properly installed casing with lid gaskets should keep any floodwater from getting in. See the photo of a gasketed well lid.



If the well lacks a protective collar, one should be installed. To do so, first dig around the well to a depth one-foot less than the collar length. For example, for a collar three feet in length, dig down two feet; then the collar's lid will stick up one-foot. Pour grout into the hole to a depth of about four inches. Push the collar into and through the grout so that the bottom of the collar is in soil. Fill the area around the outside of the collar with grout to ground level and let the grout harden. Make sure that the power supply chord and water piping coming out of the collar are gasketed at the interface with the collar – this will keep water from seeping into the collar. A certified plumber or well installer should be hired to do the work. The sketches shown here graphically depict the sort of assembly that should be sufficient to keep floodwaters from inundating your well.

If the well does have a collar, check whether the gaskets are cracked. This checking will require removing the lid cover. If the lid cover gasket needs replacing, you should also replace the other gaskets, too – if they are not cracked, they probably will be soon. A plumber or well installer should also complete this work.





Flood - 102

Maintain storm drains on your property

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Potential Hazard

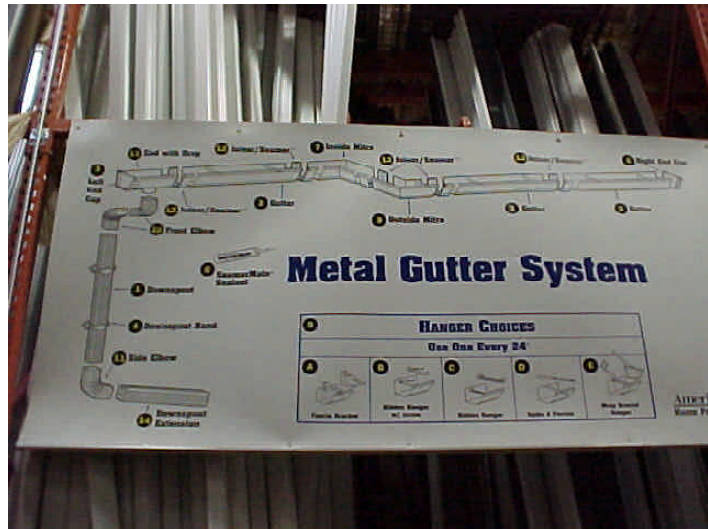
Most roads, paths and properties are sloped so flood and rainwater go to storm drains that collect and carry it away. If the water's path is blocked or the storm drain gets clogged, the water will take a long time to drain or may not be able to drain at all. Then the water collects until it gets high enough to flow another way. This new path could lead right into your home.



Water ponding against the side of your house could also damage its foundation. Saturation of the soil could cause the foundation to settle, and thereby weaken the structure above it.

Mitigation Measure

To reduce your chances of water damage to your home, you need to maintain the guttering, storm drains and flow paths on your property. During a severe rainstorm, leaves and other debris in your gutters may block rainwater from flowing away safely. You should remove debris as needed and leaves after the trees are bare so the water can move away from your home. Also, keeping the guttering downspouts and splash blocks in good condition will help to move unwanted water away from your home.



Gutter guard, a wire mesh with reinforced edges, can be placed over the guttering to keep out leaves that can cause blockages in the downspouts.



After the water has moved through the guttering to the ground, it must go across your property to the storm drains. Therefore, you need to keep the grading from your home and towards the drains clear. For example, you should remove or relocate large raised or built-up flowerbeds, piles of leaves and other garden materials that block or slow the flow of water



away from your home. Also, be sure to clear debris from drainage ditches or gullies regularly so they can carry the water to the storm drain. If there is an area where water ponds against the side of your home, that location may be a good place to plant flowers or shrubs and raise the earth to create drainage away from your home. You may be able to obtain fill dirt from other places on your property, your local government, or a landscaping company.



Flood - 103

Install a gas safety cut-off valve

Flooding is the most frequently occurring disaster in the United States. Most damage comes from river or ocean flooding, but it can also result from the flooding of small streams or creeks that rise quickly.

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Potential Hazard

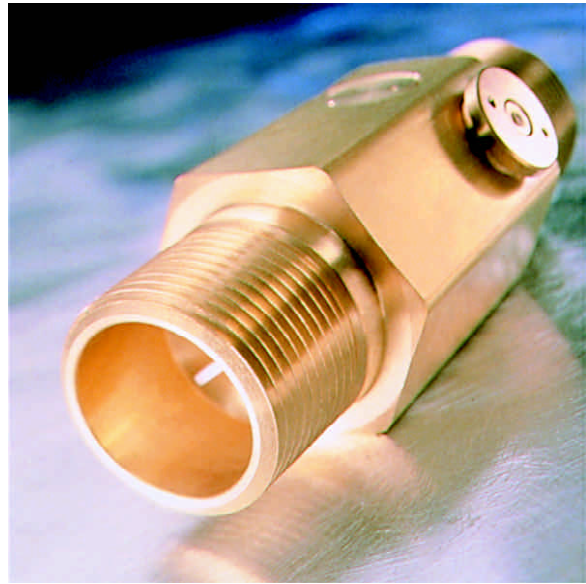


Floodwater often damage gas pipes. Gas pipes can be damaged from even minor floods when they crack or split, or when your appliances shake or are knocked over because your home shifts. Then natural or propane gas may escape into your house and create a serious threat of fire or an explosion. Injuries to you, your family, your home, your neighbors, and the environment may result.

Mitigation Measure

If you are replacing a portable kerosene heater or putting in bottled or tank based propane or natural gas heating systems, then a gas safety cut-off valve is an appropriate and good low-cost mitigation measure for reducing the risks of a gas leak into your home. One such device is

the Sanders Safety Cut-Off Valve, which is installed on your gas pipe outside the home. The Sanders Valve has been approved by the American Gas Association. This self-contained, one-inch valve fits on the low-pressure side of the regulator leading to a gas pipe. Its spring stops the flow of gas whenever there is a break in the pipe or a drop in gas pressure, which may happen when there is an accident or natural disaster. Because the valve is placed in-line above ground, it is easy to determine if a home already has one installed. One needs only to find the gas meter or propane tank and see if the valve is in line near to the meter or the tank.



Installing the valve has many benefits to you. It shuts off the gas flow at the first sign of a gas pipe break or pressure drop, and the valve remains closed until inspection and repairs have been completed. Thus it removes the danger of gas escaping into your home and causing a fire or explosion. The valve does not require any special attention from you because it automatically resets after repairs have been made. Also, it is weather resistant and does not require any power to operate, so it is very cost-effective. Because it is adaptable to a wide range of situations, it can be installed without any digging on your property.



Besides providing protection during a flood, the cut-off valve also provides protection for pipes that could be damaged during an earthquake.

To assemble, install, or service the Sanders Safety Cut-Off Valve, a state-certified plumbing and heating technician or gas utility technician will be required. It should be noted that the valve will work for high or low pressure systems and is easily set.



Flood - 104

Anchor and elevate fuel tanks & AC units

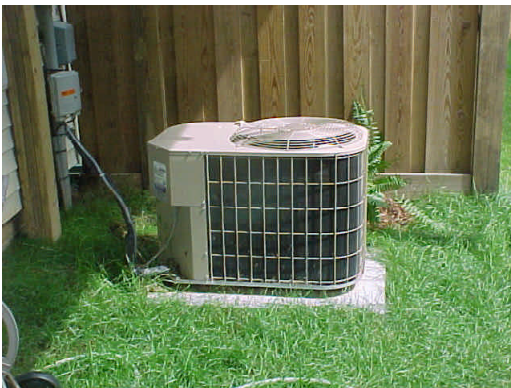
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Potential Hazard

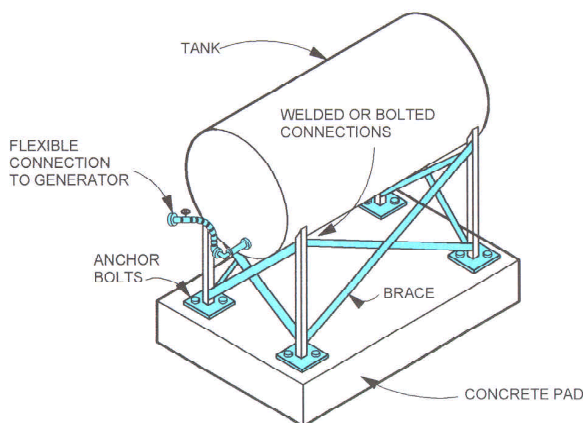
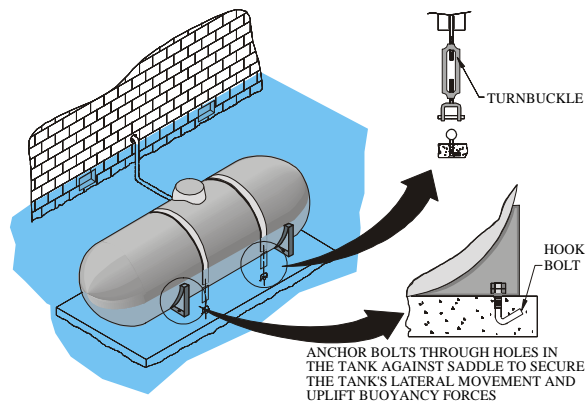
Floodwaters can easily move unanchored fuel tanks, which then may tip over or float. Escaping fuel may result in spills and fires. These tanks pose serious threats not only to you, your family, and your house, but also to public safety and the environment.



An unanchored tank outside your house can smash into your walls and be swept downstream, where it can damage other houses. Even a buried tank can be pushed to the surface by the buoyant effect of soil saturated by water. When floodwaters move an unanchored tank in your basement, the supply line can tear free, and contaminate your basement with oil.

Mitigation Measure

There are several ways to anchor your fuel tank. A method that can be used for any tank, whether it is inside or outside your house, is to attach it to a large concrete slab whose weight is great enough to resist the buoyant and lateral forces of floodwaters. You can anchor an outside tank by running straps over it and attaching them to ground anchors. Use fasteners made of non-corrosive metal like stainless steel or galvanized metal. The structural supports can also be of non-corrosive metal or pressure treated wood. You should also elevate the vent tube above the base elevation. The type of anchorage needed depends on the tank's size and size and stability of the structure it is being attached to.



Whether your tank is indoors or outdoors, keeping it topped off will increase its weight and thereby reduce its tendency to float. If you have adequate warning of a hurricane or other major rain event, ask your fuel company to top off your fuel tank. If your home lies in a flood-prone area and your tank is in the basement, it is especially important to top it off.

To protect an air conditioning compressor or heat pump, elevate it and its service lines to at least a 12" safety margin above the base flood elevation (BFE), including all filling and ventilation tubes. Use a base of masonry, concrete, or pressure treated lumber. If your air conditioner or heat pump is outside, install it securely on a platform above your flood protection level.



Flood - 105

Anchor your home

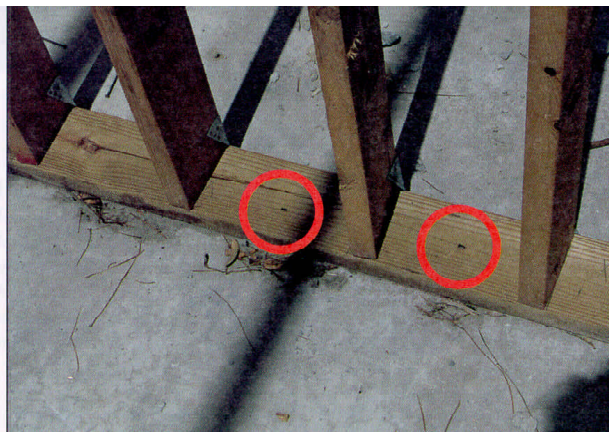
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Potential Hazard

If your home is not adequately anchored to its foundation, it may float away in high floodwaters. Your home may also be pushed from its foundation by the pressure of floodwaters against a sidewall. Houses with wood framing and lightweight covering materials that float are at great risk.



Manufactured homes have additional hazards. They are often anchored to the ground with large pins, called ground anchors. They pull out of water-soaked ground far more easily than from dry ground. A floating or moving home also becomes a hazard that can cause great damage to other structures.

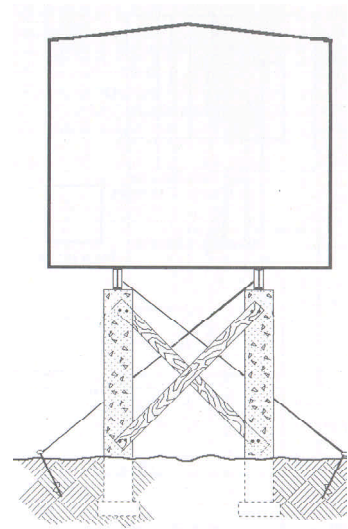
Mitigation Measure

The best protection from these problems is to secure your house to the ground or to a heavy concrete foundation.

A typical single family home should be secured to its foundation through its wooden sill or base plate with half-inch diameter anchor bolts spaced at four feet or less and in sufficient embedment.



Manufactured homes can be secured in several ways. To determine your best securing strategy, you must have site-specific flood information. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the ground by anchors whose embedded length and type are determined by your type of soil. See *Manufactured Home Installation in Flood Hazard Areas*, FEMA Publication 85, for more information.



A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately, considering the possibility of soil saturation and soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood crosspieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wood or steel rods and provides even greater stability.

A manufactured home that is elevated on fill material, such as soil, and is on flat land where expected floodwater speeds are low may not require additional securing.





Flood - 106

Apply protective sealant to your walls

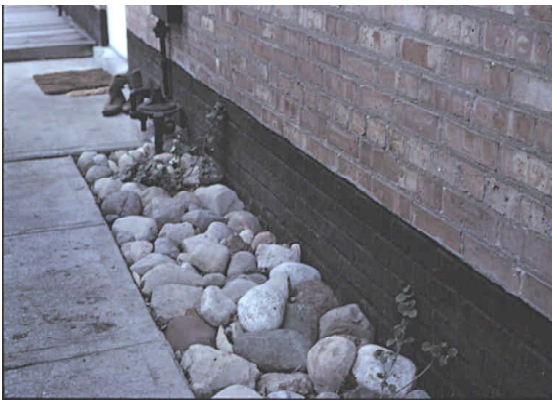
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Potential Hazard

Many homes are flooded by shallow floodwaters. Floodwater even less than two feet deep can severely damage your home if it comes inside. Repairing damage to your walls and floors can be expensive, and you may not be able to live in your home while the work is being done.

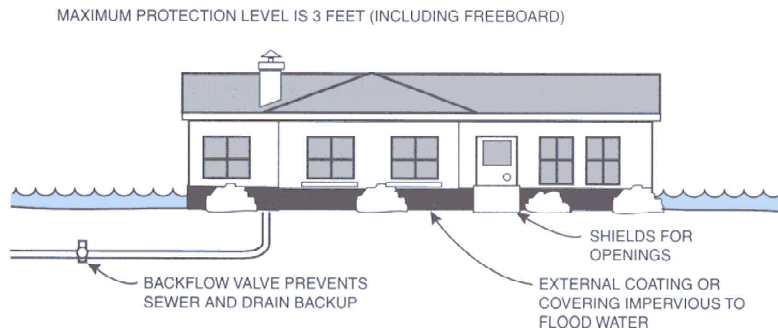


Mitigation Measure

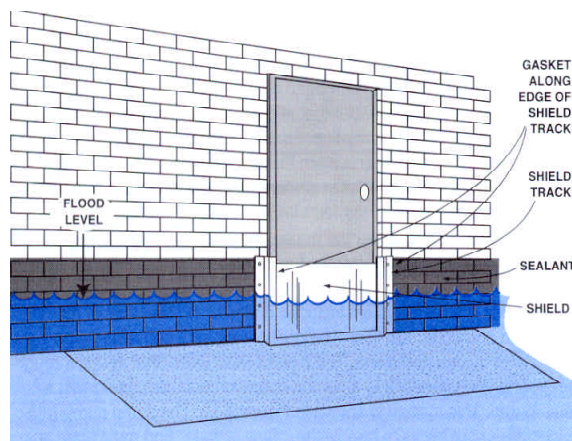
For many homes, it is not economically feasible to raise the entire home one-foot above the Base Flood Elevation (BFE).

Therefore, you need to waterproof your home. One way to do so is to put protective sealants on your walls. To protect your house from shallow flooding, put a waterproof veneer on its exterior walls and seal all openings, including doorways. This method should be used only for

homes that have flood depths less than three feet and should not be used on manufactured homes. The sealant application should not extend higher than one foot above BFE. This limitation is important because typical masonry or frame walls usually require additional bracing or strengthening if they have more than three feet of pressure from still water.



A sealant mitigation measure can be a veneer or layer of brick backed by waterproof sheeting. Before applying the veneer, remove the siding and replace it with exterior grade plywood sheathing. If necessary, extend the existing foundation footing to support the brick. Also, because the veneer will be exposed to floodwater, you might need to make changes to the interior walls so they will resist moisture damage if water gets through the protective coating. In the area below the flood level, replace standard batt insulation with washable closed-cell foam insulation. Use exterior grade lumber for any wood blocking added inside the wall cavity.



All openings, both windows and doorways, need to be flood-proofed, too. You can waterproof doorways and low windows with a removable shield made of either metal or wood. Install a special gasketed sill in the bottom of doorways to ensure a waterproof seal. Bolt the door shield to the frame of the doorway against a gasketed mounting strip. Similarly, mount the window shield against a gasketed window-mounting strip to a height of one foot above the BFE.

Notes:



Flood - 107

Install a septic backflow preventer

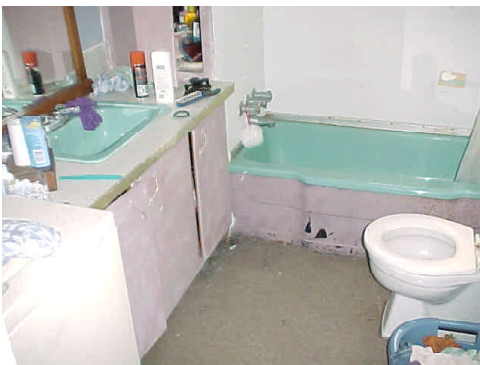
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Potential Hazard

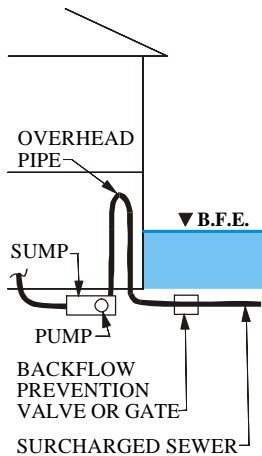
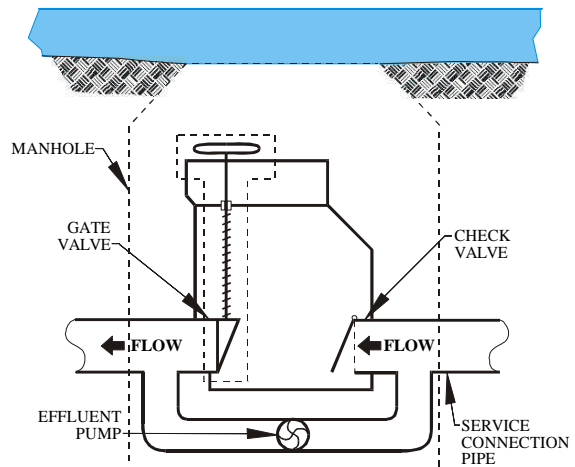
When people think of their home flooding, they usually picture floodwaters coming through windows, doorways, and leaky walls. Another way floodwater can enter the home is through gravity drains, such as septic lines and sump drains. A back up of sanitary sewer lines, which brings sewage into your home, creates an unhealthy situation. Repairing the damage may be expensive, and you may not be able to live there until repairs are made.



Mitigation Measure

A good way to protect your home from sewage backups is to install backflow valves, which are

designed to block drainpipes temporarily and prevent flow into your home. Valves should be installed on all pipes that leave the home or are connected to equipment that is below the potential flood level. Therefore, valves may be needed on washing machine drain lines, laundry sinks, fuel oil lines, and sump pumps, as well as sewer/septic connections. Sump pumps are included because they may be connected to an underground drain line and, as a result, may require excavation before installing a valve.



Backflow valves are available in a variety of designs that range from the simple to the complex. The figure shows a gate valve, one of the more complex designs. It provides a strong seal, but must be operated by hand; therefore, its effectiveness depends on how much advance warning you have of the flooding. Among the simpler valves are flap or check valves, which open to allow flow out of the home but close when the flow reverses. These valves operate automatically but do not provide as strong a seal as a gate valve. Sump drains can be protected in a similar fashion. Some valves incorporate the advantages of both flap and gate valves into a single design.

If you are connected to a municipal sewer system you may consider installing a backflow valve. There have been instances where the municipal sewer system has been surcharged causing flooding in homes that are above the base flood elevation.

Changes to the plumbing in your home should be done by a licensed plumber or contractor, who will ensure that the work is done correctly and according to all applicable codes. This is important for your safety.

Notes:



Flood - 108

Consider wetproofing options

Flooding is the most frequently occurring disaster in the United States. Most damage comes from river or ocean flooding, but it can also result from the flooding of small streams or creeks that rise quickly.

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Potential Hazards

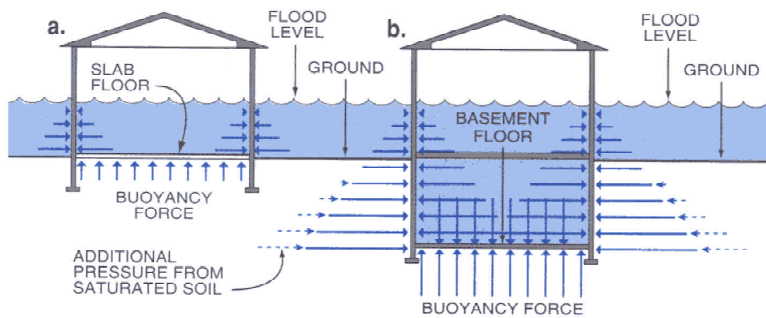
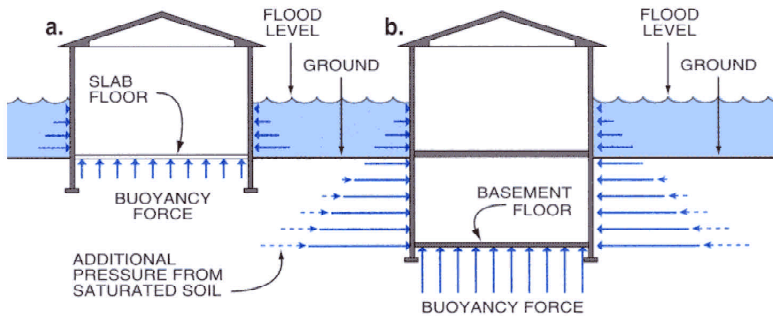
There is a danger to homes if floodwaters are kept out during extended periods of severe flooding. If the walls are not strong enough to resist the pressure, the water could collapse them and destroy the home. This risk is especially strong if the floodwater regularly rises three feet or more. Another potential risk is that if the home is too watertight, it will become buoyant, pull away from the ground anchors or foundation, and float away.



A secondary hazard is that the floodwaters continuously deposit debris and potentially contaminated silt and mud which create health risks. The presence of the silt and mud makes cleanup more difficult and causes moisture to persist. The moisture can create further damage to your home after the floodwaters have receded because mold and mildew thrive in a damp environment. As a result, you may not be able to live in your home for a long time and could have to replace materials that are not water-damaged.

Mitigation Measure

Wet floodproofing is the term for measures taken to protect one's home from these hazards. Wet floodproofing allows the house to flood and avoid structural damage. It uses flood resistant materials and the relocation of appliances and equipment to minimize damage and speed recovery. One measure you can take is to ensure that there is adequate venting so that water moves freely under your home. The venting also helps the crawlspace dry after the floodwater has receded. Any bracing added to the walls should not block these openings.



To protect against damage from long-term standing water inside your home, you can install a floating drain plug in the lowest floor of your home. This solution is most appropriate for manufactured homes. However, any home with a crawl space underneath could

benefit from having floating plugs in the lowest floor. If you let water into your home, the pressures are equalized inside and out so your home does not become buoyant.

As floodwaters recede, the floating drain plug allows water to escape. As the water drains out through the plug, much of the silt and mud may also exit. Your home will still be very dirty; however, with the plug strategically located and easily accessible, your cleanup should be easier.

Another measure is to utilize flood resistant materials below the base flood elevation. These materials will resist damage due to flooding and will not need to be replaced when the flooding recedes. In conjunction with flood resistant materials you should consider relocating appliances and utilities above the base flood elevation.

See FEMA 312 "Homeowners Guide to Retrofitting" and <http://www.fema.gov/mit/rfit>.



Flood - 109

Install interior or exterior flood walls

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Potential Hazard

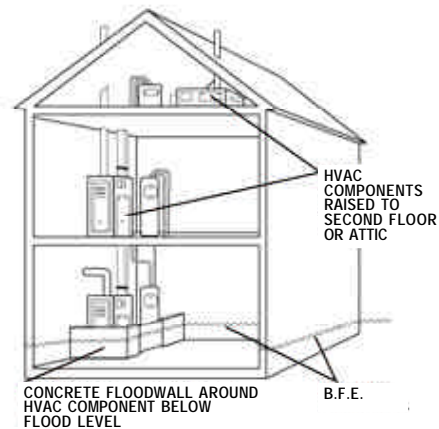
Nuisance or marginal flooding one to two feet deep affects some areas, usually those near the edge of the floodplain. In these areas, anything in the basement, particularly electric appliances, is at risk from water damage. Appliances that are in water for even short periods will probably have to be replaced. Another serious problem is the risk of fires caused by short circuits in flooded systems. Also, cleaning up and making repairs without having electricity are even more difficult.



Mitigation Measure

Flood barriers can protect your property. They work best where flooding is less than three feet deep. First, decide whether to have the flood barriers on the outside of your home or around critical appliances inside your home.

An interior floodwall can protect your home against low levels of flooding. It must be constructed of either concrete blocks or poured concrete and reinforced with steel rods to resist the pressure of the floodwaters. Anchor the new wall into the existing basement wall and floor so floodwaters will not move it. It should be built to one foot higher than the Base Flood Elevation (BFE) but no higher than three feet (for strength reasons). To protect against seepage through the floodwall or basement wall, install a sump pump with a floating switch. The pump's outflow hose should drain the water over the edge of the floodwall. An alternative to an interior floodwall is to relocate utilities to a upper floor above the base flood elevation.

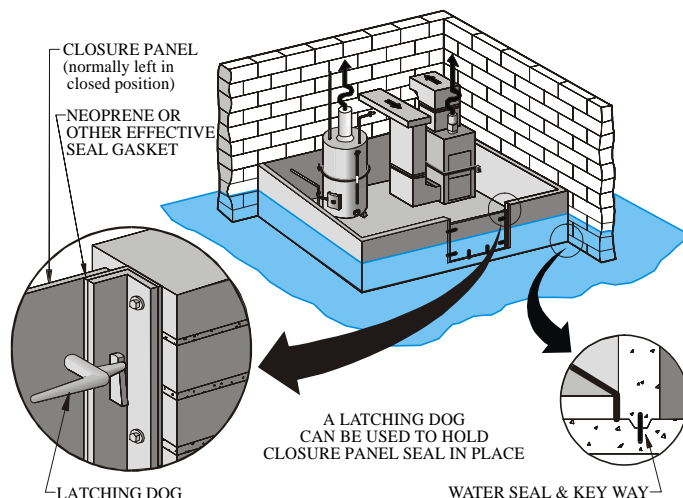


Exterior floodwalls, prevent floodwaters from reaching your home. Floodwalls, usually built of concrete, must be at least one foot above the BFE. Outside berms are small levees, usually built from fill dirt, around window wells or other openings through which flood waters may enter the structure. For best protection, do not install gates that open into the enclosure. It is important to properly evaluate the likely flood conditions and your soil conditions.

Floodwalls, berms, and levees can either surround the building (ring levee) or connect to high ground. They can also be built up against a building's foundation walls. Pumping out water that seeps under the walls will require a sump pump. Similarly, an exterior floodwall constructed of masonry or properly reinforced poured concrete can protect a window well or stairway against low-level flash flooding. In this case, only individual portals are protected because prolonged flooding is not expected. Walls should be supported by and securely tied to a

footing so that they will not be undercut by scouring. Once again, the wall should not be higher than three feet.

See FEMA Publication 348, *Protecting Building Utilities From Flood Damage*.





Flood - 110

Relocate or elevate internal appliances

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Potential Hazard

Nuisance or marginal flooding affects some areas of the country, usually those at the edge of the base flood elevation (BFE). If the area has floods of no more than one or two feet, it



may not be cost effective to raise your home to avoid future floods. Anything in your basement is at risk to water damage, especially an appliance that depends on electricity. If it is in water for even a short time, it will probably have to be replaced. Another serious problem is the potential for fires caused by short circuits in flooded electrical systems. In addition, after a flood, cleaning up and making repairs without having electricity are made more difficult.

Mitigation Measure

If only your basement floods regularly, it is easier to relocate or elevate appliances and critical utilities than to raise your home. Typical basement appliances and utilities include clothes washers and dryers, hot water heaters, furnaces, and electric fuse boxes. If your basement has baseboard heaters, those heating units also need to be elevated.

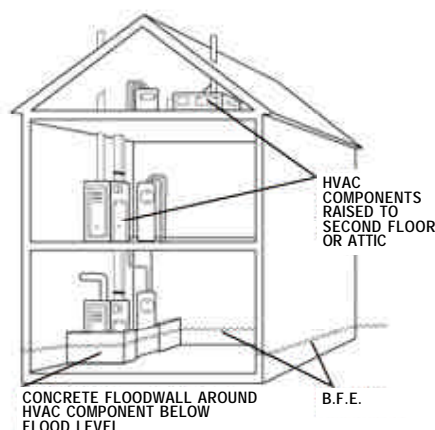
Appliances and utilities can be easily elevated a short distance. Remember to elevate them to at least a one-foot safety margin above the highest known flood level or the Base Flood Elevation (BFE). For low heights, use concrete blocks or a platform made from pressure treated lumber and supported by concrete blocks. Make certain that washers and dryers are secure and will not vibrate off the blocks or platform during use—securely fasten them with straps to the wall or floor. If you have flooding greater than two or three feet, putting these items on the next higher floor may be the best solution since there is limited headspace in the basement.



The best way to protect your valuable electrical system is to keep it from getting wet. All components of the electrical system, including the wiring, should be raised at least one foot above the BFE. Electrical work of this sort may require removing some interior wall sheathing (drywall, for example). It is a good idea to run the wires overhead. If a wire has to run into the areas where it could get wet, use a wire rated for underground use. No wire should end in the flood zone, and all junctions should be located in approved junction boxes.

In homes at high flood risk, protect the heating, ventilating, and cooling equipment by moving it from the basement or lower level of the home to an upper floor or attic. A water heater can

be put anywhere near a hot water pipe. If the existing ductwork for your furnace is below the BFE (e.g., on a slab or in a crawlspace beneath the home), relocate it so it distributes heat from above and runs free and clear of floodwaters. You can replace an updraft furnace in the basement with a downdraft furnace on a floor above the flood protection level .



See FEM A Publication 348, *Protecting Building Utilities From Flood Damage*.

Unit 3: Recognize the Risks and Mitigation Measures

Notes	Flood Exercise Sheet
Assess Flood Risks	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Flood Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	
9	

Verify Mastery	Discuss responses.
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Unit 3: Recognize the Risks and Mitigation Measures

Flood Risk Pictures

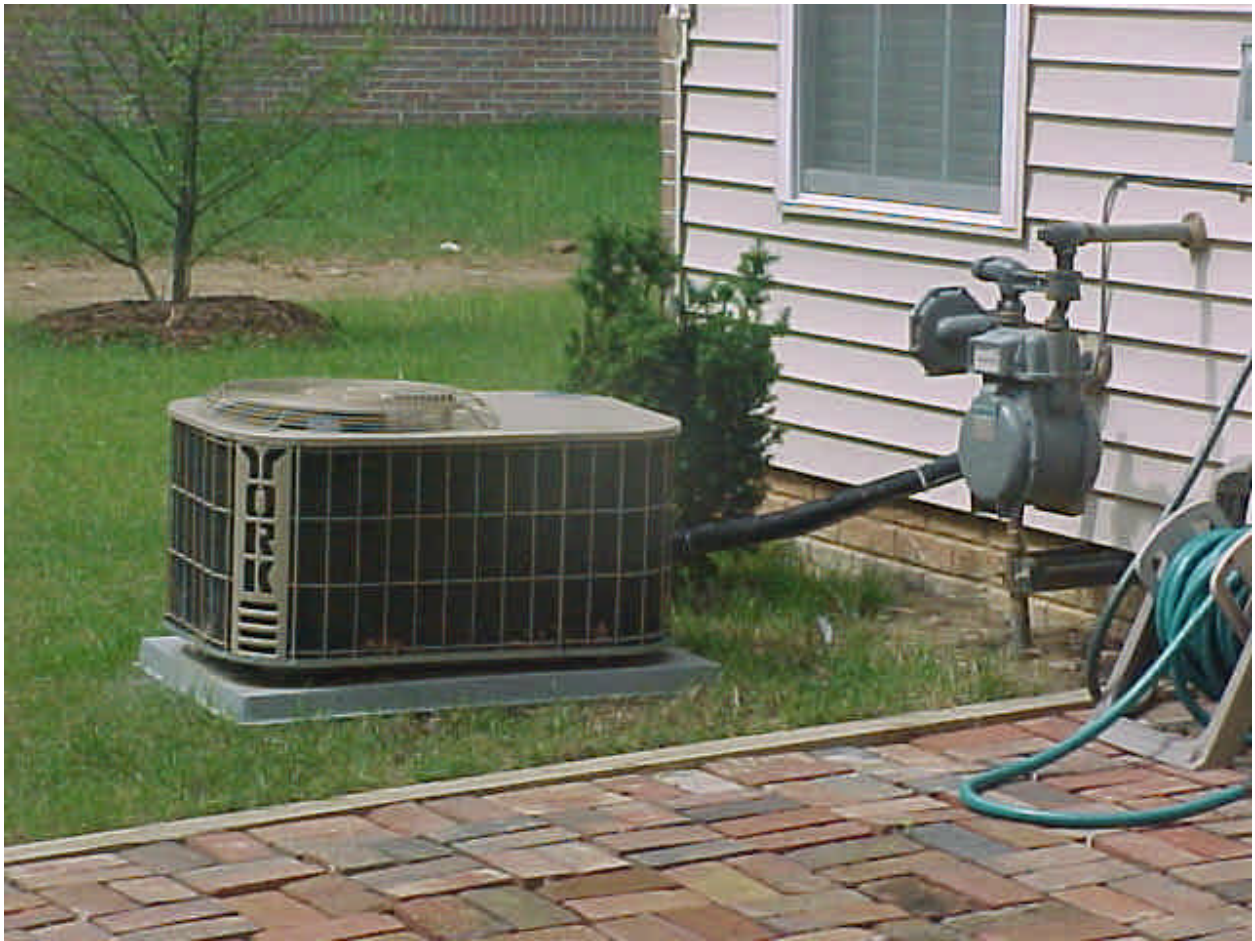
(See following 9 pages)

Flood Risk No. 1



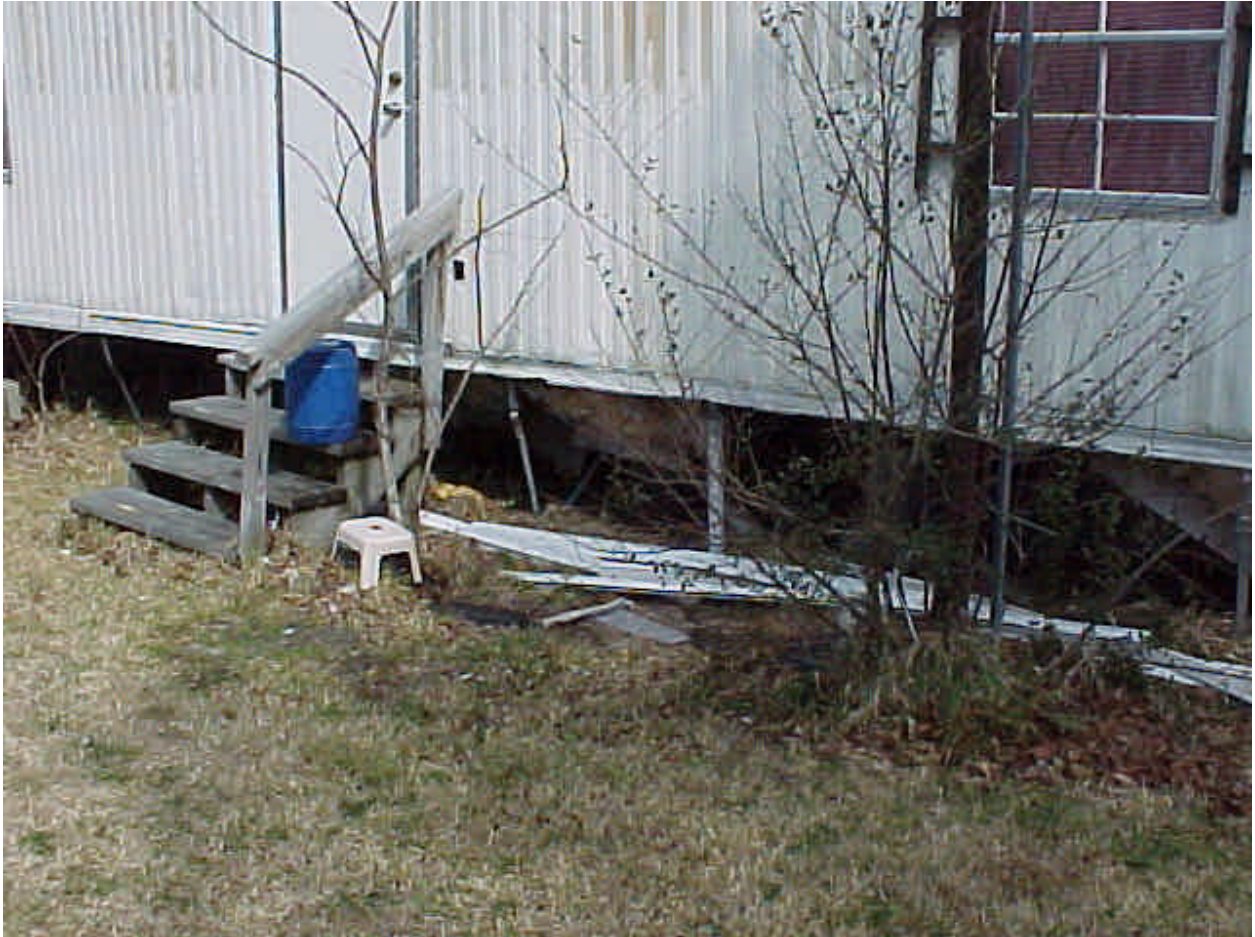
Scenario – Base Flood Elevation 1 foot above existing ground

Flood Risk No. 2



Scenario – Base Flood Elevation at ground level

Flood Risk No. 3



Scenario – Base Flood Elevation 3 feet above ground level

Flood Risk No. 4



Scenario – Base Flood Elevation at ground level

Flood Risk No. 5



Scenario – Base Flood Elevation 3 feet above ground level

Flood Risk No. 6



Scenario – Base Flood Elevation for this well housing is 1 foot above ground level

Flood Risk No. 7



Scenario – Base Flood Elevation at ground level

Flood Risk No. 8



Scenario – Base Flood Elevation at ground level

Flood Risk No. 9



Scenario – Base Flood Elevation 1 foot above ground level

Unit 3: Recognize the Risks and Mitigation Measures

	Flood Exercise Sheet Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may not necessarily be visible in the photo.

Flood Answer Sheet	
Picture Number	Action Checklist Number
1	103, 104, 105, (would consider 107 if BFE was higher; never wetproof a manufactured home)
2	104, 106, 107 (would consider 105 and 109 if BFE was higher)
3	105, 107, 108
4	102
5	105, 108 (never apply protective sealants to crawlspaces)
6	101, 109
7	102
8	103, 104, 106, 107, 109 (would consider 105 if BFE was higher)
9	103, 106, 108, 109, 110

Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Fact Sheets – Wind (See following 10 pages)



Wind - 201

Reduce potential for flying debris

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



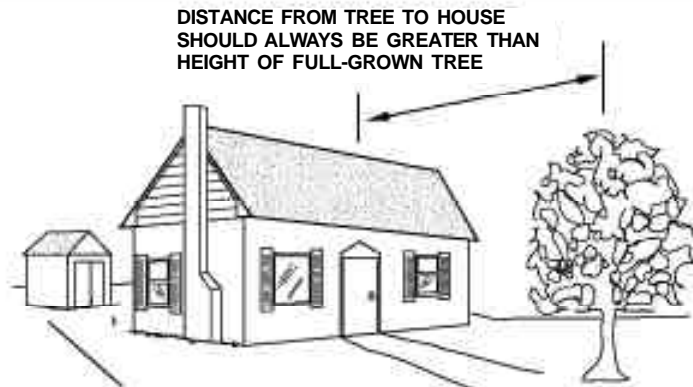
Outdoor furniture, trees, trash cans, yard debris, outbuildings, or other materials in the immediate vicinity of your home, that can be moved by the wind, are a threat that increases the risk of danger to your home during a hurricane or tornado. The wind can topple trees and tree limbs onto your house. It can also pick up smaller objects and drive them through windows and doors. Another danger is that wind can tear inadequately secured downspouts from your home.

In addition, loose shingles or other building components can fly off and increase the susceptibility of damage to your home. A small breach of the building envelope may lead to severe damage.

Mitigation Measure

You should remove dead and dying trees and potential windborne missiles like outdoor furniture. Also, make

sure that all trees are far enough away from your home so that they can't fall on it. That means the distance between your home and any unhealthy tree should always be greater than the height of the tree. Prune dead or dying tree limbs and remove unhealthy large trees, if necessary. You should also clear away any debris, such as fallen tree branches.



ANCHOR STORAGE SHED TO PERMANENT FOUNDATION OR TIE DOWN WITH STRAPS AND GROUND ANCHORS

All storage sheds and other outbuildings should be securely anchored, either to a permanent foundation or to the ground with straps and ground anchors. The same straps and ground anchors used for manufactured homes also can be used to anchor outbuildings, especially small garden sheds, which are usually not placed on a permanent foundation. Use the same method for home attachments, such as downspouts and TV antennas or dishes. Use strapping to securely fasten them to the home or ground so that they do not detach.

Smaller objects, such as trash cans, barbecue grills, and outdoor furniture, should also be anchored or, if you have adequate warning, moved indoors. You can secure trash cans with cables or chains attached to ground anchors or to wood posts firmly embedded in the ground. Fasten trash can lids to cans with chains or cables.

Notes:



Wind - 202

Anchor the base of your manufactured home

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

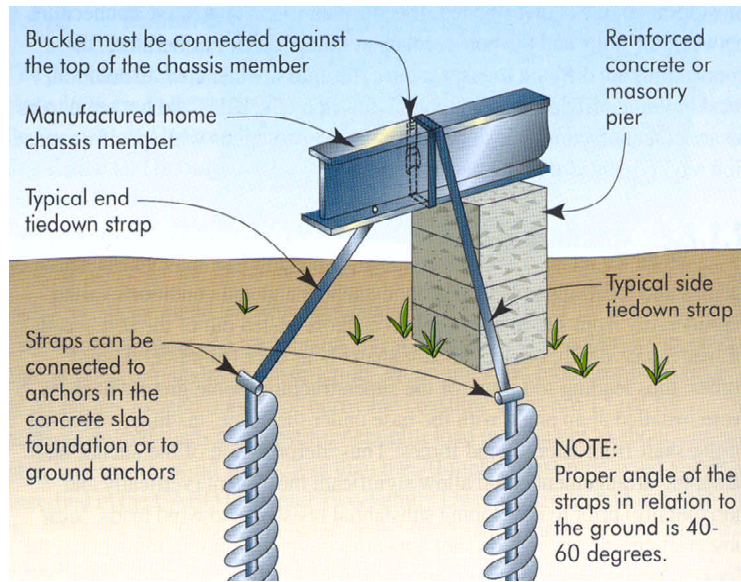
Potential Hazard



During periods of sustained high winds, a manufactured home can easily become dislodged from its foundation and, as a result, even collapse. Besides the obvious structural damage, your interior goods could also be damaged. Homes in coastal areas subject to hurricanes and in inland areas subject to tornadoes are possible candidates for mitigation. Even homes in northern states that typically do not have tornadoes or hurricanes can be subject to strong, straight-line winds that can be just as destructive as a hurricane or tornado.

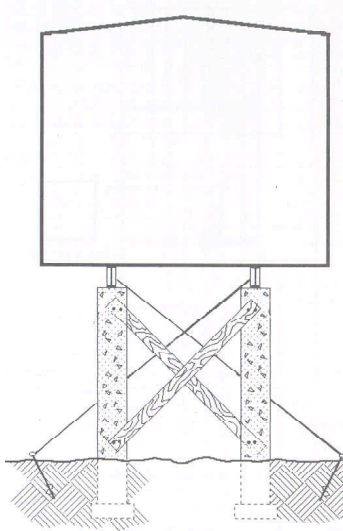
Mitigation Measure

The stability of a manufactured home can be increased by securing it to the ground or a heavy concrete foundation. Before determining the securing strategy, you must have site-specific flood information which may also include the base flood elevation. This information will help you determine how likely or to what depth your immediate area will experience flooding.



A manufactured home can be secured in several ways. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the ground by anchors whose embedded length and type should be selected for **the applicable soil type**. See *Manufactured Home Installation in Flood Hazard Areas*, FEMA Publication 85, for more information on anchoring tips.

A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately after consideration of the possibility of soil saturation and soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood crosspieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wood or steel rods and provides even greater stability. Also, the home should not rest on “dry blocks.” Use steel reinforced blocks filled with grout or concrete by temporarily raising or jacking up the home. Then insert reinforcing steel into the concrete masonry units and filled with grout.



A manufactured home that rests on fill material, such as soil, is less likely to catch wind from underneath, but it should be anchored to the foundation by ground anchors.

A typical single family home should be secured to its foundation through its wooden sill or base plate with half-inch diameter anchor bolts spaced at four feet or less and sufficiently embedded.



Wind - 203

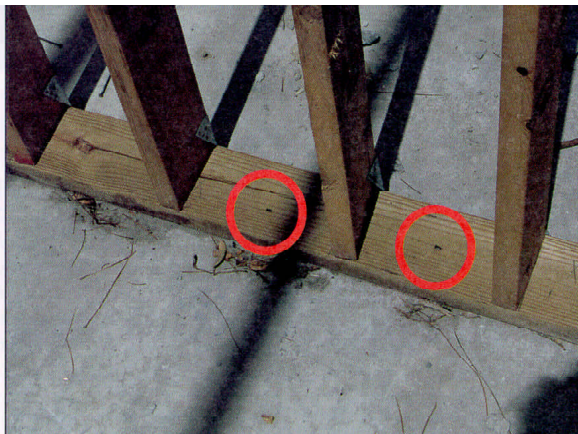
Bolt your house sill plate connection

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.

Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.



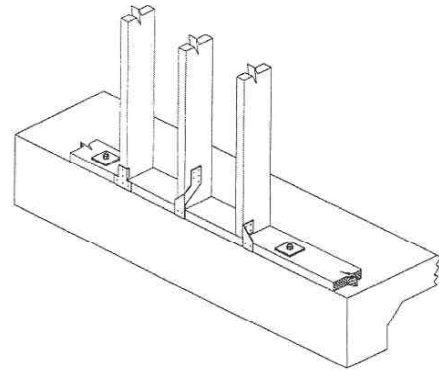
Potential Hazard



If your home is not adequately anchored to its foundation, it may become dislodged from its foundation from the force of strong winds. If your home is pushed off its foundation, it is more likely to experience structural failure. Many homes have wood framing and lightweight covering materials that can be easily lifted or moved. To make your home more resistant to the lateral and uplift forces of wind, you need to be sure that all parts of your home are firmly interconnected.

Mitigation Measure

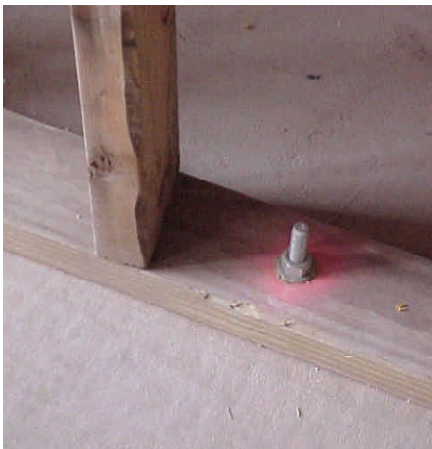
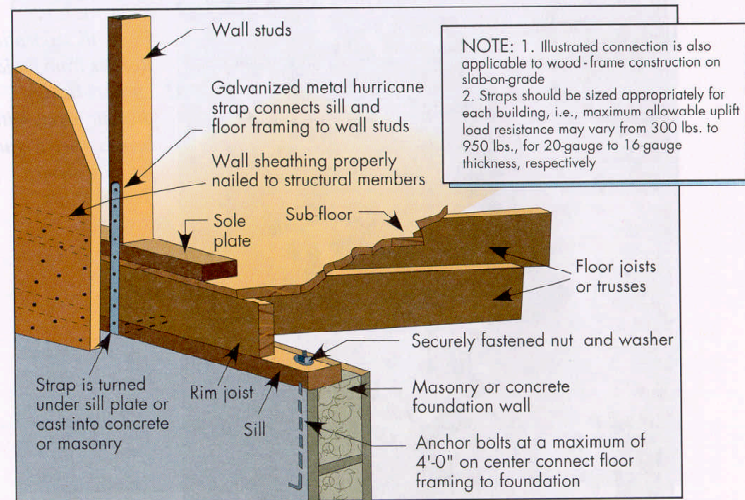
The best protection from these dangers is to secure your home to the ground or a heavy concrete foundation that transfers the lateral and uplift loads from the roof and walls of your home to its foundation.



A typical single family home should be secured to its foundation through its wooden sill or base plate with half-inch diameter anchor bolts no more than four feet apart, according to the manufacturer's installation instructions. The wall studs also should be secured to the base plate and foundation with straps. For existing homes, use concrete anchors to attach the strap to concrete. To properly seat a concrete anchor, which is a special type of screw, a hole must be predrilled into the masonry $\frac{1}{4}$ " deeper than the anchor. The anchor can then be screwed in by using a power drill with a screw bit.

Whether you live in a detached home with a crawl space or a manufactured home, you can secure your home in several ways. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the

ground by anchors whose embedded length and type should be selected for the applicable **soil type**. See *Manufactured Home Installation in Flood Hazard Areas*, FEMA Publication 85, for more information on anchoring.



A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately after consideration of the possibility of soil saturation and soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood crosspieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wood or steel rods and provides even greater stability.



Wind - 204

Increase your gable end bracing

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard

During a windstorm such as a hurricane, homes with gabled roofs are more likely to suffer damage than those without gables. Each end of a gabled roof is shaped like an “A,” with the outside walls extending to the peak of the roof. During a strong windstorm, those walls take a beating, so gables that are not properly braced can collapse and cause major damage to the roof.



Gabled roofs are more susceptible to damage by high winds than hip roofs or flat roofs. The wall on a gabled end presents a large surface to the wind and receives its full force. If the framing of the gabled ends and the rest of the roof are not adequately braced to resist the wind, the wall can buckle or fall, and then the roof can fail. Roof failures, especially for unbraced gabled roofs, are a common cause of major damage to homes and their contents in high winds.

Mitigation Measure

If your house has a gabled roof, you should check to see whether the roof framing is braced. After inspecting your roof framing, a building official can tell you whether additional bracing is required.



One methods of gable end bracing consists of 2x4s placed in an “X” pattern from the top center of the gable to the bottom center brace of the fourth truss, and from the bottom center of the gable center to the top center brace of the fourth truss. Use two 3” 14-gauge wood screws or two 16d (16 penny) galvanized common nails to attach the 2x4s to the gable and each of the four trusses. See attached figure for an example of proper bracing.

Notes:

[illegible]



Wind - 205

Replace gable vent with slotted vent

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



Wind breaking into your house during a windstorm is particularly hazardous because it can break apart your roof and walls. A small breach of the building envelope may lead to severe damage to your home. Wind and rain coming in also can damage the interior contents of your home.

Mitigation Measure

It is recommended that you provide venting with adequate openings to relieve induced pressures on your roof structure. However, be

sure the venting you install prevents the entry of uncontrolled airflows. Such uncontrolled airflow could result in buildup of induced internal air pressure, which is also dangerous. It is desirable to use a power-operated vent that can be opened during normal weather and closed during storms to prevent uncontrolled winds from entering.



Notes:

[illegible]



Wind - 206

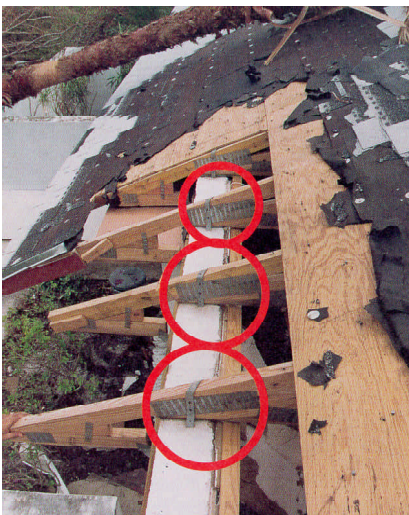
Fasten your roof & walls with hurricane straps

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



During a windstorm, the force of the wind pushes against the outside of your home. That force is passed along from your home's roof to its exterior walls and then to its foundation. Homes can be damaged or destroyed when the energy from the wind is not properly transferred to the ground.

In most homes, gabled roofs are built from manufactured rafters. Sheets of roof sheathing, often plywood, are fastened to the rafters with nails or staples, and roofing material is fastened to the sheathing. In many cases, the rafters are held in place only by the plywood on top. This arrangement may not be enough to hold the roof on your home during a strong windstorm like a hurricane.

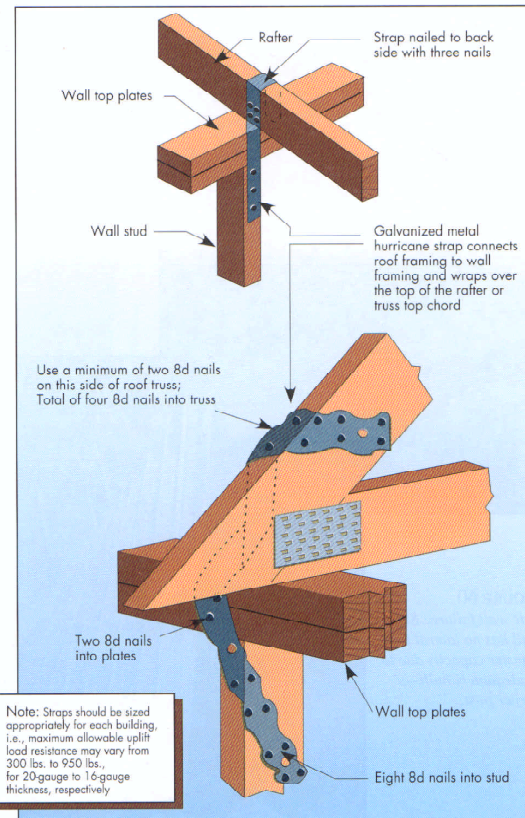
Mitigation Measure

To improve the connection between your home's roof and its walls and foundation and thus reduce the risk of losing your roof to high winds, you should install hurricane straps or clips. Hurricane straps or clips will help hold any type of roof to the walls. Inspect your attic for hurricane straps or clips of galvanized metal.

To install hurricane straps or clips, remove the roof sheathing around the edge of the roof to reveal the horizontal underside of the eave. Also remove the exterior covering to reveal the top 12" to 18" of the wall. If the exterior covering is brick veneer, you may need to remove small sections of brick.

If your roof has trusses, make sure you tie them to the wall either by anchoring them to the top plate and then the top plate to the wall stud, or strapping the truss directly to the wall stud. You can anchor the roof to the top of the wall of wood or masonry homes with straps or connectors.

Similarly, for two-story buildings, the upper story should be secured to the lower floor level. Use at least four 8d nails to secure the galvanized floor tie anchors to each of the top floor studs, floor joists or trusses, wall top plate, and first floor wall studs. To secure the straps or clips to wood, use a minimum of two 8d nails on either side of the truss for a total of four 8d nails. In addition, use two 8d nails to secure the strap or clip to the spine of the truss, if possible. Use two 8d nails to secure the strap or clip to the wall top plates. Use eight 8d nails to secure the strap or clip to the wall stud.



If you need to connect the strap or clip to masonry, you can use concrete anchors, which are screws designed for concrete embedment. Predrill holes for the anchors $\frac{1}{4}$ " deeper than the anchor to allow for dust from predrilling. Concrete anchors $\frac{1}{4}$ " in diameter and $2\frac{1}{4}$ " or $2\frac{3}{4}$ " long should be sufficient. Power tools are recommended for seating the screw.



Wind - 207

Improve the securing of your roof sheathing

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard

During a windstorm, the force of the wind pushing against the outside of your home is very strong. Roof systems are particularly vulnerable to strong winds because they are elevated

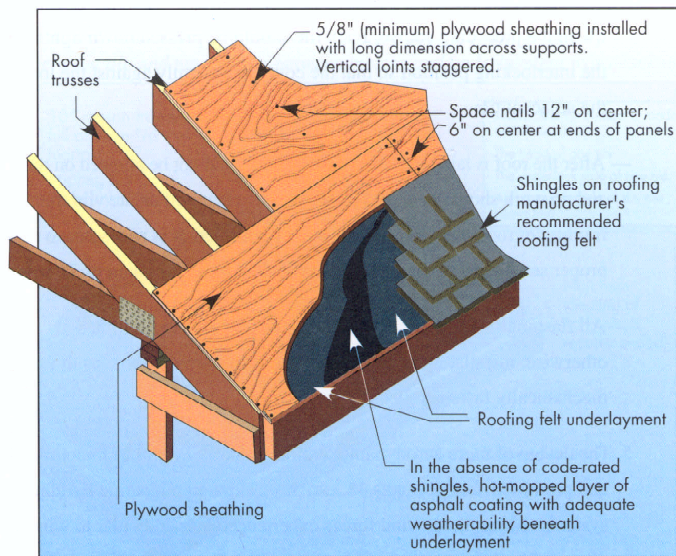


and thus, very exposed. The force from the wind is passed from your roof to the exterior walls and then to the foundation. Homes can be damaged or destroyed when the energy from the wind is not properly transferred to the ground.

In most homes, gabled roofs are built using manufactured rafters. Sheets of roof sheathing, often plywood, may not be enough to hold the roof on your home during a strong windstorm like a hurricane.

Mitigation Measure

Roof sheathing can be reinforced from underneath without removing a roof that is in good condition. You can fasten the brackets into place with screws, nails, or a high-strength adhesive. Make sure the screws or nails do not puncture or pass through the plywood sheathing. If you use a high-strength adhesive, you may need to insert a shim to create a little space where you can shoot the glue. Be sure the high-strength adhesive you choose has the product approval code AFG01, which will appear on its packaging; that is your assurance that the product is suitable for this purpose.



If your roof is being replaced, use plywood sheets that are at least 5/8" thick. They should be oriented so that the long dimension goes across the supports (not parallel to them). Also, the vertical joints should be staggered. The spacing of nails along the border of the plywood panels should be 6" on center. Spacing in non-border areas should be 12" on center. Use screws rather than smooth-bodied or even ridged nails because they are less likely to be pulled out.

Notes:

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Wind - 208

Improve closure of your windows and doors

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard

Strong wind events can cause damage for many reasons. The outside walls, doors, and windows are the protective shell of your home. If that protective shell is broken, high winds can enter,

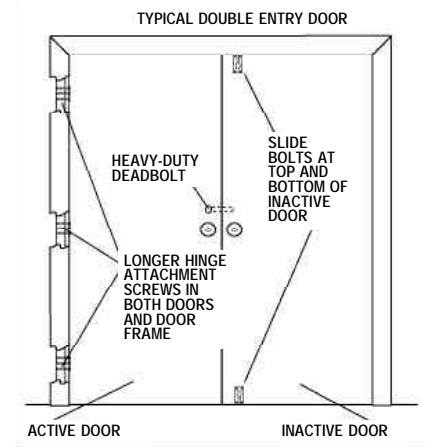
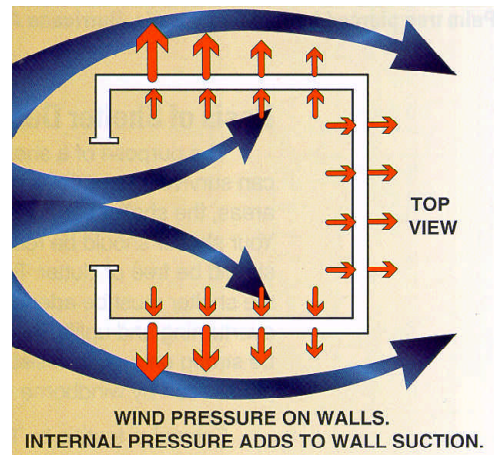


put pressure on your home's roof and walls, and push them apart. Also, the wind can carry heavy objects and debris, which can then become deadly missiles. In hurricanes and tornadoes, pressure differences between the inside and outside of your home can cause windows to shatter and break. Rain which heavy winds drive through a broken window into your home can be a major cause of damaged household goods. Shards of broken glass could also cause painful and severe injury or death to you and your family.

A common misunderstanding is that windows should be left open to equalize and stabilize pressure on your home. The truth is that if hurricane winds enter any opening, damage is much more likely to occur because of the increased internal pressure on walls and roof supports.

Mitigation Measure

You can protect your home by strengthening its doors and windows. Make sure all windows, doors, and openings are fitted with bolts and impact resistant materials. Adding slide bolts and dead bolts to your windows and doors will also increase your family's general security. Safety window film will hold glass shards in place, thereby reducing potential injuries, deaths and property loss from flying glass. If you use tinted safety glass, you will increase the energy efficiency of your home by reducing the effect of solar heat in summer and retaining heat in winter. You can add tinting to a window or door that already has safety glass.



Replacement of your windows and sliding doors is probably most beneficial in coastal areas where the threat from high winds occurs regularly. However, inland areas also frequently experience strong winds. If your home is in a high-risk area from strong winds and a window or door needs replacing because it does not close properly, it may be beneficial to replace it with one that is impact-resistant. Because the impact-resistant products are relatively new, you should consider replacing only standard-size windows and sliding glass doors.

Notes:



Wind - 209

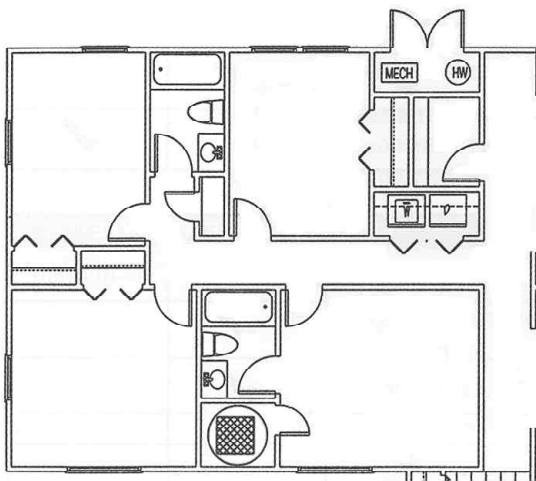
Create a safe area in your home

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.



Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.

Potential Hazard



Mitigation measures can help reduce damage to property caused by extreme winds. However, even after you apply mitigation measures, you still face risks to life and property. Modern technology has provided warning of hurricanes early enough so that coastal areas can be evacuated before storms arrive. Unfortunately, hurricanes also can travel far inland and cause great damage. With tornadoes, nor'easters, and straight-line winds, though, there often is little warning. However, you can reduce the number of lives lost by protecting yourself and your loved ones inside your home.

Mitigation Measure

Residents of tornado and hurricane-prone areas can build a “safe room” or in-residence shelter as protection against deadly tornadoes and hurricanes. A safe room, or in-residence shelter, is a small windowless room, such as a closet or bathroom, readily accessible from all parts of the house, designed to provide protection for your family. Its purpose is threefold - to save lives, reduce injuries, and relieve anxiety.

The safe room is appropriate for both existing residences and newly constructed homes. *Taking Shelter from the Storm: Building a Safe Room Inside Your House*, FEMA Publication 320, outlines a room shelter design, including construction plans, materials, and cost estimates. One free copy of this document is available to each homeowner by calling 1-800-480-2520. The publication was developed by FEMA with Texas Tech University’s Wind Engineering Research Center, Lubbock, Texas.

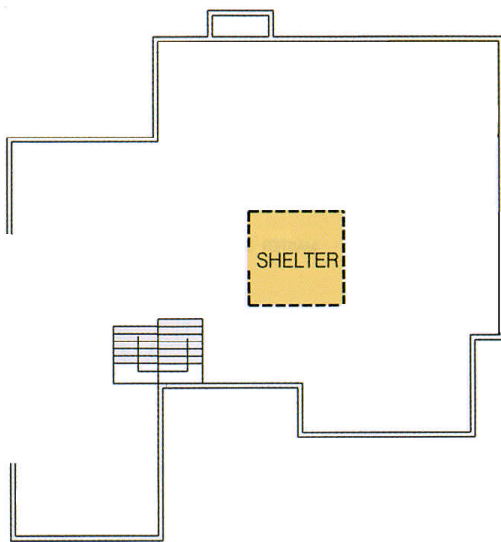
Research from inspections of homes in more than 90 towns and cities which were struck by tornadoes revealed that, in most cases, small rooms in the central portion of the house remained



Surviving Interior Rooms



Surviving Interior Room



standing even when the rest of the house was severely damaged or completely destroyed. This realization led to the conclusion that these interior rooms could be reinforced to provide a high degree of occupant protection at a reasonable cost. A shelter built according to the FEMA Pub. 320 plans can provide protection against winds of up to 250 miles per hour and flying objects traveling at 100 miles per hour.

If you live in an area where there are tornadoes and hurricanes, consider constructing a safe room in your home. Remember: mitigate now—before the next windstorm—to save lives later.



Wind - 210

Improve the bracing of your “A” frame roof

Many parts of the United States are exposed to wind hazards of varying degrees. This threat could be from a tornado, hurricane, or localized winds from canyons or mountains. In some cases, the wind can be strong enough to destroy a home, piece by piece. Winds that pick up debris that strikes your home or car can also be very dangerous. Often the damage is caused by flying debris on or near your property.

Although you cannot accurately predict where and when a strong wind might occur, you can use precautions or mitigation measures that reduce the potential for damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs.



Potential Hazard



Because the roof is the highest point of a home, it will likely suffer great stresses and loads from windstorms, like hurricanes, tornadoes, straight-line winds, and nor'easters. Keeping the roof on your home is the first, and maybe most important, step in weathering the storm. If your roof comes off or fails partially, damage to your interior contents is almost a certainty.

To see what sort of bracing your roof's rafters have, go into your attic. If the attic does not have a floor, be careful to walk only on the wood joists. Also, notice how the plywood is attached to the rafter system

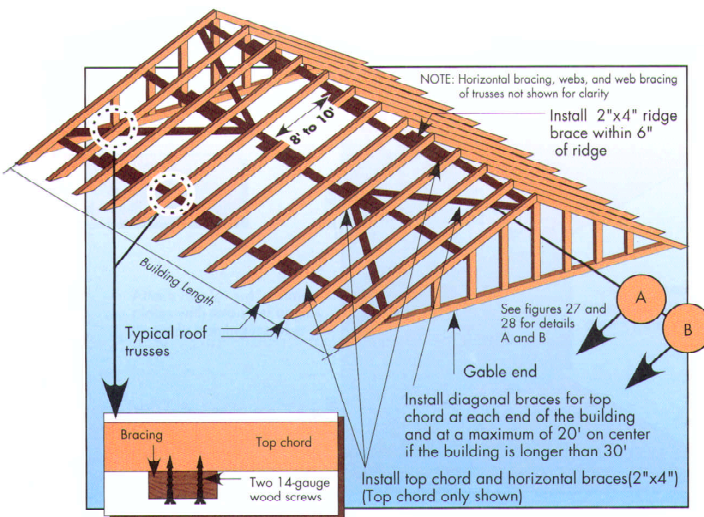
For an A-frame roof, sheets of roof sheathing, often plywood, are fastened to the rafters with nails or staples, and roofing

material is fastened to the sheathing. If most of the large nails or staples coming through the sheathing have missed the rafters, consider having the sheathing properly installed. (See Fact Sheet 207.)

In many cases, the rafters are held in place only by the plywood on top. This arrangement may not be enough to hold the roof in place during a strong windstorm like a hurricane. Installing additional bracing makes your roof's rafter system stronger.

Mitigation Measure

If your house has a gabled roof, you should check to see whether the roof framing is braced. If you are unsure whether your gabled roof is adequately braced, make a quick inspection. If you do not see any wood perpendicular to the rafters, then they have no bracing at all. The guidelines below indicate the minimum bracing needed.



In gabled roofs, bracing usually runs the length of the roof. If you do not have bracing, it should be installed. You can do this yourself or hire a professional. Install 2x4s the length of your roof, overlapping the ends of the 2x4s across two trusses. (See Figure.) Braces should be installed 18" from the ridge, in the center span, and at the base, with eight to ten feet between the braces. Use two 3-inch, 14-gauge wood screws or two 16d (16 penny) galvanized common nails at each rafter.

Because space in attics is generally limited, screws may be easier to install. Always use screws that are at least two inches long and install them in pairs to be sure the connection is secure.

Notes:

Unit 3: Recognize the Risks and Mitigation Measures

Notes	Wind Exercise Sheet
Assess Wind Risk	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Wind Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Verify Mastery	Discuss responses.
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Unit 3: Recognize the Risks and Mitigation Measures

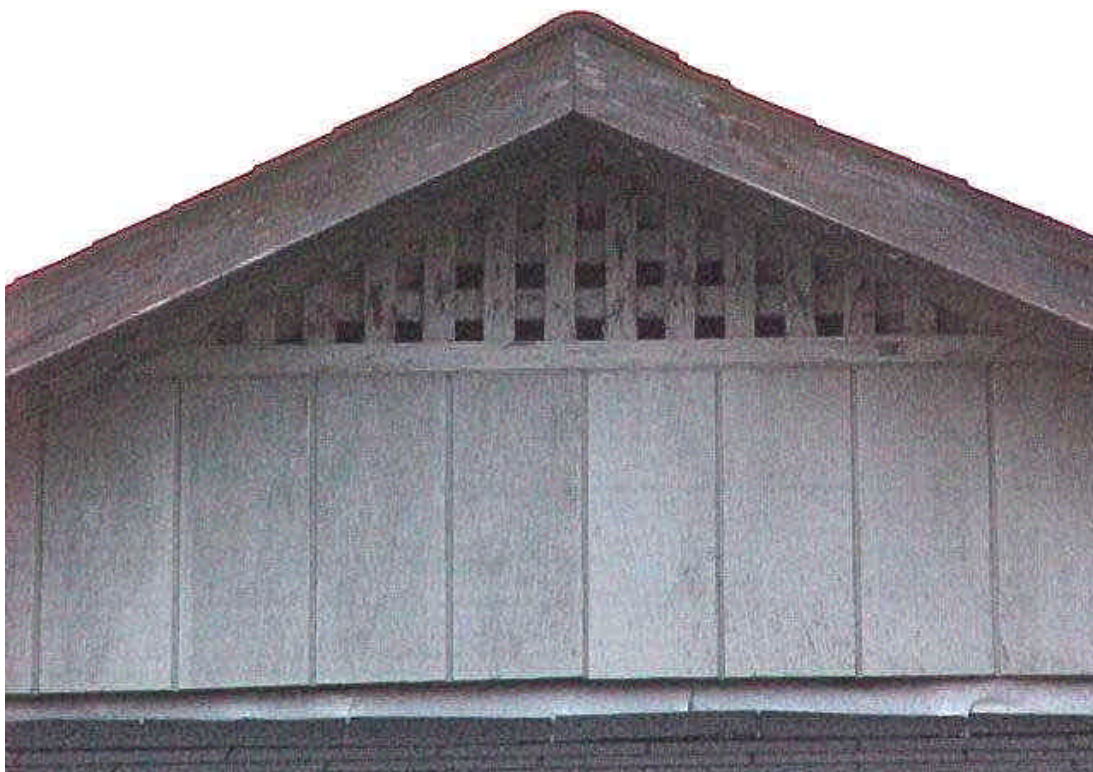
Wind Risk Pictures

(See following 10 pages)

Wind Risk No. 1



Wind Risk No. 2



Wind Risk No. 3



Wind Risk No. 4



Wind Risk No. 5



Wind Risk No. 6



Wind Risk No. 7



Wind Risk No. 8



Wind Risk No. 9



Wind Risk No. 10



Unit 3: Recognize the Risks and Mitigation Measures

	Wind Exercise Sheet Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may necessarily be visible in the photo.

Wind Answer Sheet	
Picture Number	Action Checklist Number
1	204, 206, 207, 210
2	204, 205, 206, 207, 210
3	201, 206, 207
4	201, 202, 208
5	201
6	201, 202
7	201, 206, 208
8	201, 202, 208
9	201, 202
10	210, 206

Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Fact Sheets – Earthquake

(See following 10 pages)



Earthquake - 301

Install a gas safety cut-off valve

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

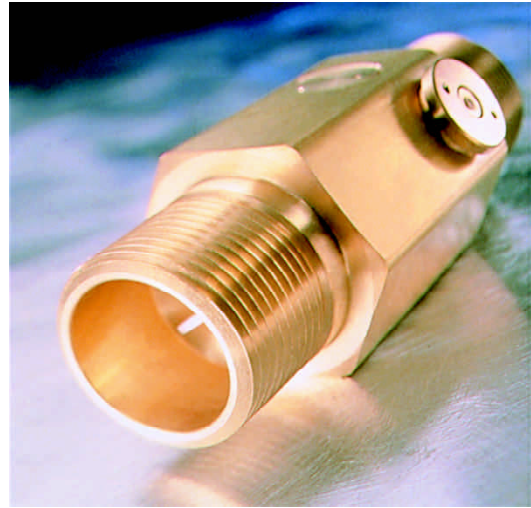
Potential Hazard



An earthquake is movement of the earth's crust that causes the ground to shake or tremble. As a result, earthquakes often damage gas pipes. Gas pipes can be damaged from even minor earthquakes when they crack or split, or when your appliances shake or are knocked over because your home shifts. Then natural or propane gas may escape into your house and create a serious threat of fire or an explosion. Injuries to you, your family, your home, your neighbors, and the environment may result.

Mitigation Measure

If you are replacing a portable kerosene heater or putting in bottled or tank based propane or natural gas heating systems, then a gas safety cut-off valve is an appropriate and good low-cost mitigation measure for reducing the risks of a gas leak into your home. One such device is the Sanders Safety Cut-Off Valve, which is installed on your gas pipe outside the home. The Sanders Valve has been approved by the American Gas Association. This self-contained, one-inch valve fits on the low-pressure side of the regulator leading to a gas pipe. Its spring stops the flow of gas whenever there is a break in the pipe or a drop in gas pressure, which may happen when there is an accident or natural disaster. Because the valve is placed in-line above ground, it is easy to determine if a home already has one installed. One needs only to find the gas meter or propane tank and see if the valve is in line near to the meter or the tank.



Installing the valve has many benefits to you. It shuts off the gas flow at the first sign of a gas pipe break or pressure drop, and the valve remains closed until inspection and repairs have

been completed. Thus it removes the danger of gas escaping into your home and causing a fire or explosion. The valve does not require any special attention from you because it automatically resets after repairs have been made. Also, it is weather resistant and does not require any power to operate, so it is very cost-effective. Because it is adaptable to a wide range of situations, it can be installed without any digging on your property.



Besides providing protection during an earthquake, the cut-off valve also provides protection for pipes damaged during a flood.

To assemble, install, or service the Sanders Safety Cut-Off Valve, a state-certified plumbing and heating technician or gas utility technician will be required. It should be noted that the valve will work for high or low pressure systems and is easily set.



Earthquake - 302

Brace your manufactured home

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

Manufactured homes and modular buildings not attached to permanent foundations need special consideration when located in earthquake-prone areas. These structures can slide or topple off their foundations if not properly secured to resist shaking and require reinstallation. Manufactured homes are seldom destroyed by earthquakes; however, they are often damaged. Even moderate earthquakes may dislodge these homes from their support system (piers), allowing them to fall to the ground. Accessory structures such as awnings, decks, skirting, etc., are racked and twisted beyond repair when the home shifts off the support piers. Earthquake-related fires are usually the cause of destroyed manufactured homes during



earthquakes. Fires typically originate from a ruptured gas line where it connects to the home or to an appliance. Manufactured homes are required to have gas lines secured in place. However, many times when a homeowner replaces appliances, they are not secured and become the source of ignition when the gas connection is broken or ruptured by earthquake shaking.

Mitigation Measure

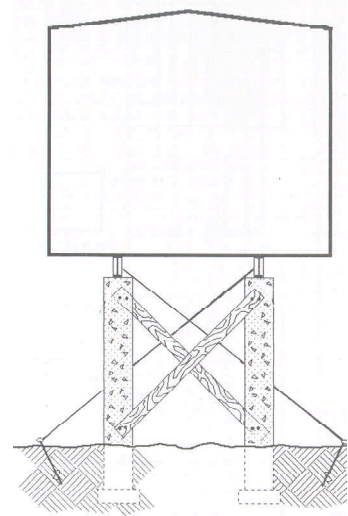
Special earthquake stabilizing devices for manufactured homes are available. Check with earthquake retrofit specialists in your area. These devices have proved to be effective in preventing or minimizing damage in several recent earthquakes.

Structural engineers advise that four precautions will improve the earthquake readiness of a manufactured home. Keep the axle, wheels, and inflated tires on the unit; reduce interior hazards in the same way as for other housing; install an earthquake safety device to keep the unit from falling off its supports; and install an automatic gas shutoff valve (Fact Sheet 301).

Many states have different requirements for bracing. You should contact your local Housing and Community Development office for more details. However, the California Department of Housing and Community Development (HCD) certifies Earthquake Resistant Bracing Systems for manufactured homes. These systems have been found to substantially reduce damage to homes from earthquakes. Manufactured homes can be secured in several ways. You can secure the base directly to the ground or use ties (rust-resistant straps or cables) that go over the top of your home. The ties are held into the ground by anchors whose embedded length and type should be selected for the applicable soil type. See FEMA 85 – *Manufactured Home Installation in Flood Hazard Areas* for more information.



A manufactured home elevated on piers, piles, blocks, stub walls or wood should be braced and anchored appropriately for the soil type. There are two common methods of bracing or securing a manufactured home. Knee bracing can be wood cross pieces or wire straps attached to the horizontal beam supporting the home. Diagonal bracing uses wooden or steel rods and provides even greater stability.





Earthquake - 303

Bolt your house sill plate connection

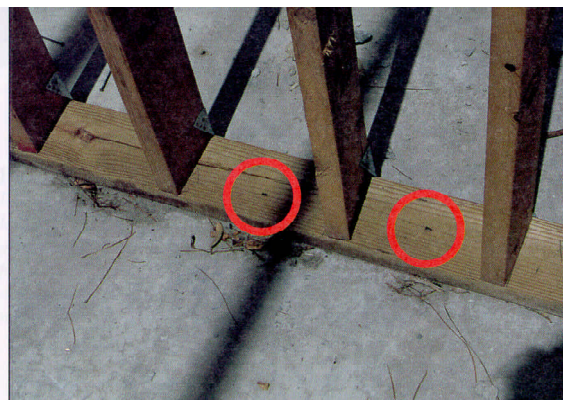
Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

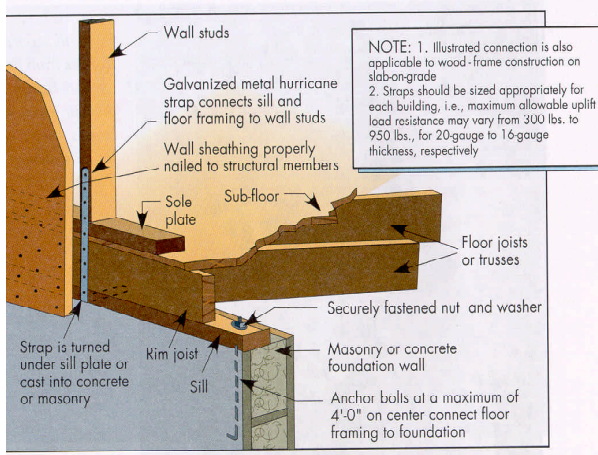
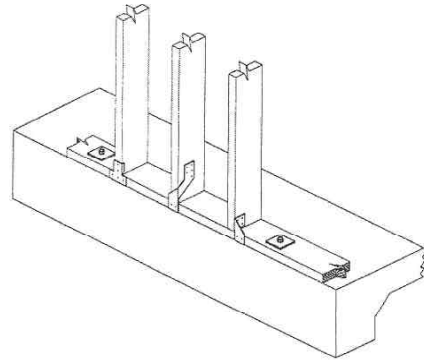
Potential Hazard

The sill plate of a house rests directly on top of its foundation. It is usually a wooden 2"x 6" or 2"x4" board that runs the length of the foundation upon which the floor or cripple wall of a home stands. If the sill plate for your home is built on a cripple wall and crawl space foundation, your house will be especially susceptible to earthquake damage. If the sill plate is not securely anchored, an earthquake can cause it to shift on the foundation. When this shifting occurs, there is a significant potential for severe damage to your home as well as injury to you and members of your family. The picture to the left illustrates an inadequately secured foundation that used nails instead of bolts.



Mitigation Measure

The best protection from problems associated with your home's shifting is to secure your house to the ground or to a heavy concrete foundation. This action will transfer lateral loads from the walls of your home to its foundation. First, one must determine if the sill plate has already been secured. To conduct an inspection if the house rests upon a cripple wall, you will need access to the crawl space under the house. Upon entering the crawl space, look for evidence of bolts going through the wood sill and into the foundation. A home on a conventional foundation is a little harder to inspect. Not infrequently, however, it is possible to perform a limited inspection. Sometimes you can remove the ventilation screens and, using a flashlight, visually inspect the area where the sill plate meets the foundation.



A typical single family home should be secured to its foundation through its wooden sill or base plate with $\frac{1}{2}$ " diameter anchor bolts which penetrate several inches into the foundation and are spaced at four feet or less along the base of the exterior walls. This method is not limited to cripple wall construction; it can also be used for a house built on a basement or slab-on-grade foundation or on another type of crawl space foundation.





Earthquake - 304

Brace your cripple walls

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

A cripple wall is a short wall between the foundation and its main structure. The cripple wall is usually between one to two feet high. This usually means that the home has a crawl space underneath. This cripple wall supports the floor and exterior walls. An unbraced cripple wall can shift during an earthquake and the house could fall off its foundation. Even a minor earthquake can cause the cripple wall to crack, buckle, or crumble, thus undermining the home's stability. If your house is built on a cripple wall foundation, brace the cripple wall to increase your home's structural stability and reduce earthquake damage.



Mitigation Measure

Diagram illustrating the construction details of a foundation and wall assembly, showing the relationship between various components:

- EXTERIOR SIDING
- EXISTING BLOCKING BETWEEN JOISTS
- SUBFLOOR
- FLOOR JOIST
- NEW PLYWOOD OR ORIENTED STRAND BOARD
- CRIPPLE WALL STUD
- NEW BLOCK AT TOP AND BOTTOM OF CRIPPLE WALL
- SILL PLATE
- FOUNDATION

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Earthquake - 305

Brace your masonry chimney

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.

Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.



Potential Hazard

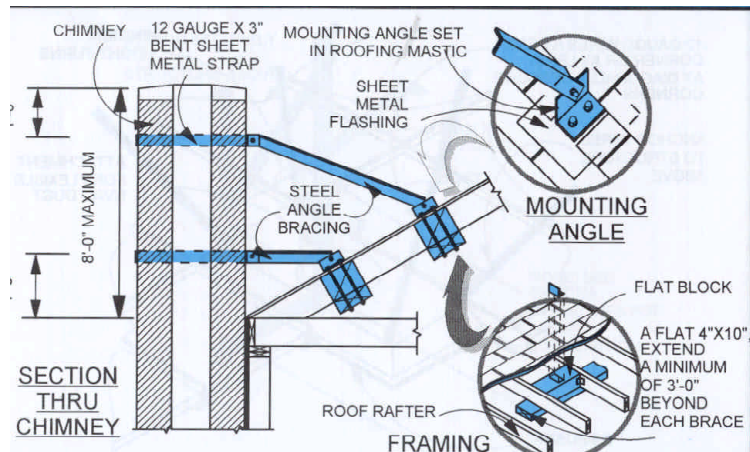


Chimneys installed before 1960 may not be properly reinforced and tied to the building. Be especially careful about very tall chimneys, which could fall in the direction of an exit path. Or worse, the chimney could fall onto the home. Usually when this happens to brick chimneys, the heavy weight crashes through the roof and into the home as illustrated by the picture above. When checking the chimney to see if it is already strapped, be careful not to confuse strapping used to secure an

antenna as straps used as part of chimney bracing like in the photo to the left.

Mitigation Measure

To protect the investment you made to the roof like insulation, strengthened roof sheathing, or truss bracing, increase the security of your masonry chimney. If the top of the chimney is flush with the roof, the chimney is probably not worth retrofitting because of its decreased likelihood of falling. Chimneys that extend beyond the roof line should be secured in high earthquake risk areas. To increase the safety of your chimney during an earthquake, first reinforce the sub-roof around the chimney with 2"x4" boards that are perpendicular to the roof rafters or trusses. Use at least two 16d nails to secure it to each rafter and 1/2" diameter bolts to go through the roof into the added 2x4's. This shoring up is needed to anchor the chimney braces. Braces consist of 2" wide 16 gauge steel straps. At least two should be used – one at the top of the chimney and one at or just above the roof line. The straps are secured to the roof with angle 2"x2"x1/4" steel angle braces. Refer to the sketch above for a graphic illustration. This strapping should mitigate the shaking effects of earthquakes upon your chimney. Furthermore, be sure to seal the areas around where you have penetrated the roof with bolts.



After an earthquake, be sure to check and repair the chimney as needed.

Notes:



Earthquake - 306

Use flexible connections for gas and water

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



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Potential Hazard

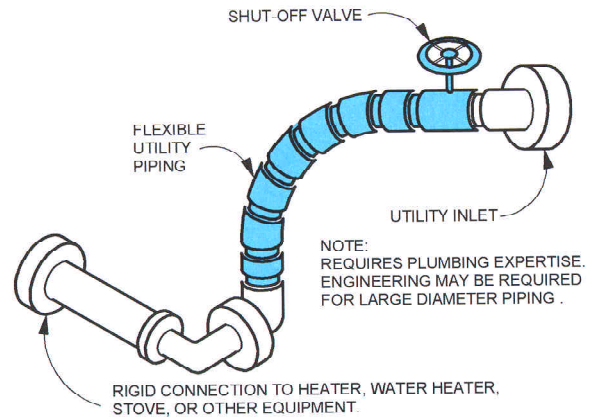


Most water and gas supply lines have rigid pipes and connections. These lines can be torn away or ruptured during an earthquake. The results could include not only serious damage to your house but also injury to you and members of your family. A broken water line can flood the house interior and damage appliances and furnishings. The water could also short circuit and start a fire. A broken gas line is especially serious because the escaping gas will slowly accumulate and could cause a

fire or explosion. Even if no explosion occurs, the gas will slowly displace breathable air and cause a life-threatening atmosphere.

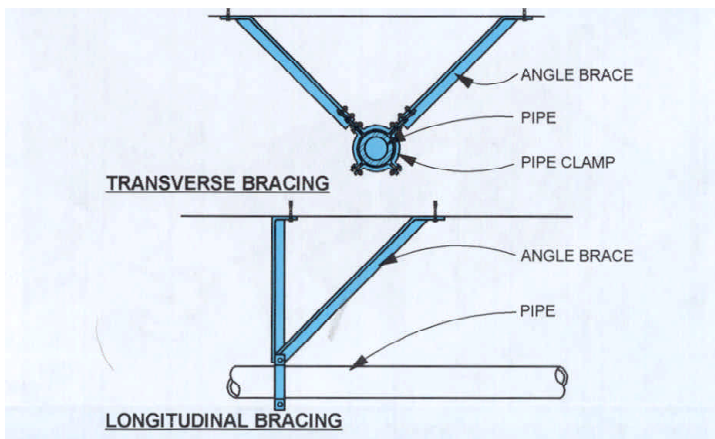
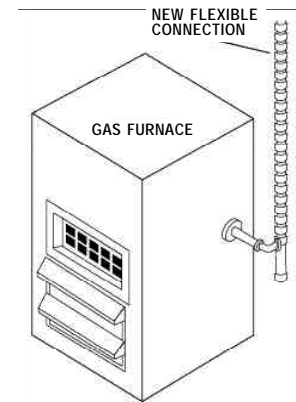
Mitigation Measure

One way to prevent broken gas and water lines is to have flexible connectors installed between appliances and their supply lines. The diagram shows a flexible connector installed on a gas furnace. You can also use a flexible connection for other appliances, such as a hot water heater, clothes dryer or stove. Only a licensed contractor should install this connection.



Flexible connectors will help reduce the risk of gas and water lines being damaged as a result of shaking during an earthquake. Installing flexible connectors should not be done instead of bracing or strapping. Flexible connectors will not help if an appliance, such as a water heater topples over; they will only help to mitigate the effects of shaking.

The supply pipes that connect to your appliances also need to be protected. This is a particularly simple mitigation measure when installing a new heating appliance or refurbishing an old one. Install brackets or angle bracing to keep the rigid pipes from moving as illustrated below.





Earthquake - 307

Strap your water heater

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



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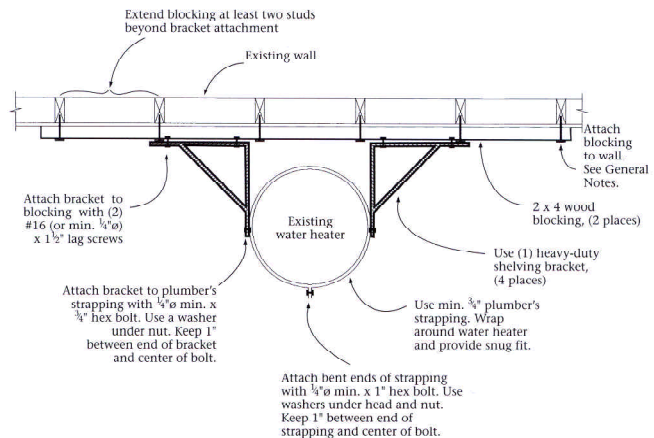
Potential Hazard



A standard water heater is the home appliance most likely to have earthquake damage because it has a high center of gravity. Although modern water heaters have been designed to be more stable than the early models, they are still likely to “walk” or even tip over during an earthquake. If this movement happens, your utility lines may be disconnected. The results may include gas or water leakage, electrical shorts, fires, or explosions. Also, if your water heater does tip over, you could lose one of your best sources of water for the period following the earthquake.

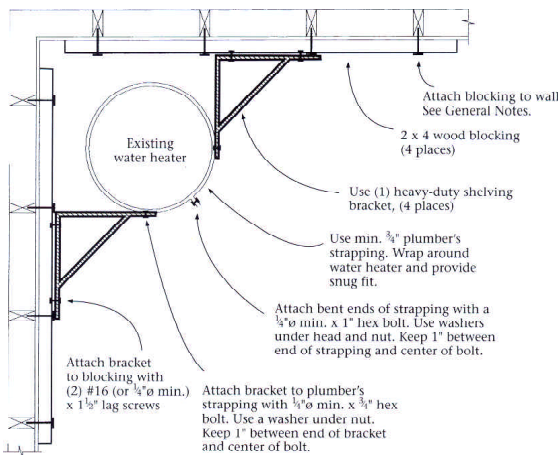
Mitigation Measure

To prevent the water heater from moving or tipping over, you need to secure it. Wrap steel plumber's tape around the entire heater at least twice. Then secure the tape to two different wall studs with 2" or longer lag screws. For added security, place blocking between the heater and the wall. This blocking could be a plywood "shelf" cut to fit the water heater's circular shape or a 2x4 or similar board behind the heater.



You should connect existing concrete or grouted masonry walls with concrete anchor bolts. There are many types, including wedge, expansion, sleeve, and epoxy. To take advantage of the full capacity of concrete anchors, space them at least 12 times the diameter of the bolt, with a minimum edge distance of 6 times the diameter. The minimum embedment length is typically 8 bolt diameters. The bolt will have a greatly reduced capacity if it is too close to an edge or an adjacent bolt or if it has insufficient embedment into the concrete. When drilling holes into concrete or masonry walls, avoid cutting any reinforcing steel (rebar) or electrical conduit by using a magnetic device to locate the steel or conduit.

The most common fasteners are wedge anchor bolts, where part of the shank expands to press against the sides of the hole as the nut is tightened. For anchorage to reinforced concrete walls, expansion anchors are the most common and easiest to install. Typical sizes for wall anchorage of non-structural items might be a 1/2" diameter A307 bolt with 4" minimum embedment, 5" edge distance, and 6" spacing. Use galvanized or preferably stainless steel bolts and other hardware where they will not be exposed to moisture, weathering or corrosion-resistant chains, eyebolts, quick-release safety hooks for gas cylinders, or other items stored outside or in a damp location.



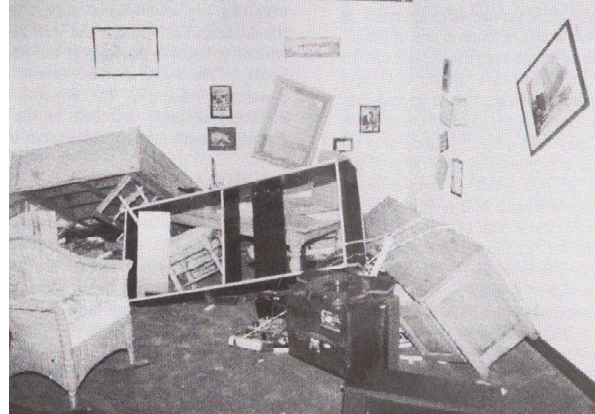
Sleeve anchors may be best for frequently moved items. Sleeve anchors consist of a threaded sleeve installed directly into the concrete, flush with the concrete surface, and a bolt that is screwed into the sleeve. When the bolt is removed, the sleeve is left flush with the wall or floor and without the bolt protruding. Epoxy anchors are inserted into slightly oversized holes with epoxy or polyester resin to hold the bolt in place.



Earthquake - 308

Secure your light home contents

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

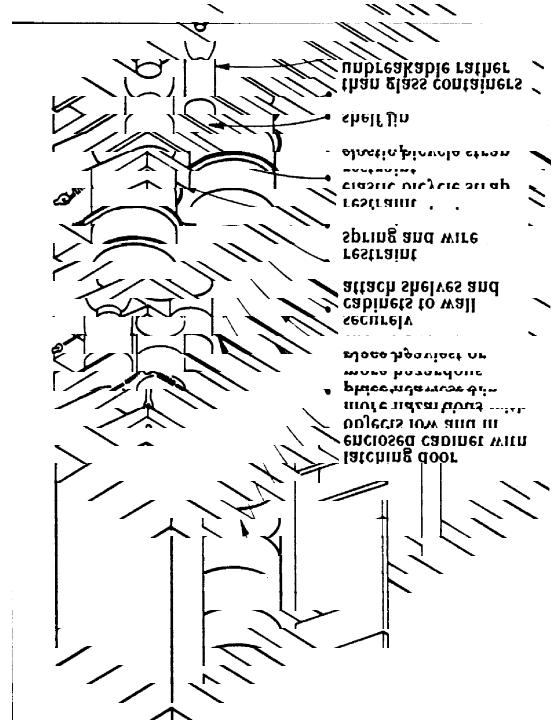


During an earthquake, falling objects could hit you and your family and cause serious injury. The strong shaking of your home may also break the glass in your home's windows and doors. The doors of your cabinets may open, so your china and other precious items fall out, and unprotected items on ordinary shelves will also fall off. Mirrors and picture glass also may break when falling from the walls. When these items hit the floor, they may shatter and spread dangerous shards everywhere. Drawers containing small objects may spill their contents on the floor. In the kitchen, these items are liable to be sharp and dangerous. Light fixtures supported by suspended ceiling grids can lose their vertical support

when the suspended ceiling sways and is distorted. Often electrical wires support pendant-mounted fixtures. When the wire splices pull apart, these fixtures also fall and break. When the fixtures swing, they can strike and break other objects. The result of the breakage will be that your home is filled with dangerous debris.

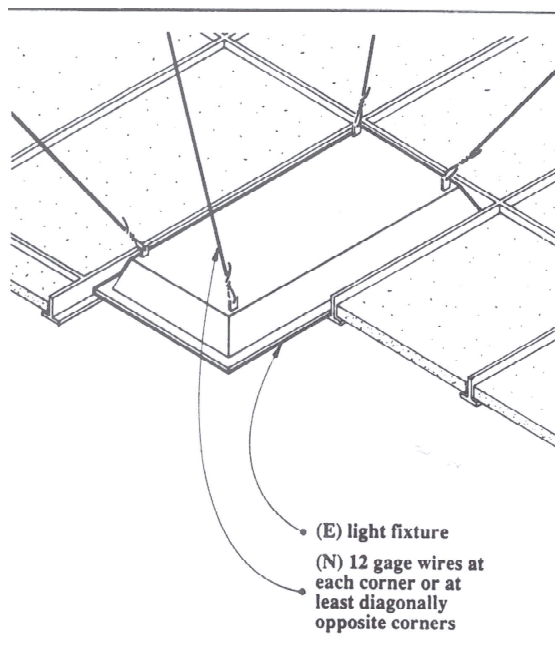
Mitigation Measure

One easy and cost-effective way to protect the glass in your home is to apply adhesive solar film to it. The film may not keep the glass from breaking, but it will prevent the glass from falling onto the floor in sharp shards. The film also will reduce heat and glare, so your home will be more comfortable and your air-conditioning and heating costs will be lowered.



You can secure cabinet doors and kitchen drawers by installing child-proof latches. You can secure light items on shelves by adding a small wooden lip or wires and springs to create an elastic lip. Another way is to use an elastic strap restraint or bungee cord around individual items. Loose shelves should be secured to their wall or shelf brackets. Wooden shelves that rest on wall-mounted brackets may be secured to the brackets with 1/2-inch-long screws. For

light and nonessential items on shelves or countertops, a 1- to 2-inch lip secured to the edge of the counter or shelf may be adequate to keep miscellaneous items from falling off. In this case, individual items do not need to be anchored.



To prevent light fixtures suspended by ceiling grids from falling, you can add independent wire ties connected directly from each fixture corner (or from diagonal corners) to the floor above. For pendant-mounted light fixtures, you can install safety wires to prevent the fixtures from falling, and diagonal wires to prevent them from swaying.

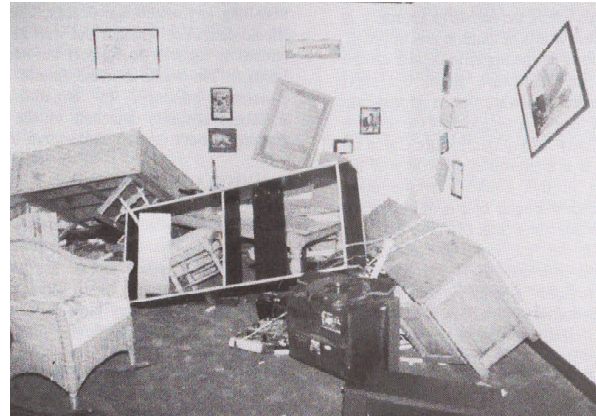
The diagram at left illustrates some of these measures.



Earthquake - 309

Secure your furniture

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard



During an earthquake, large pieces of furniture such as tall bookcases and file cabinets can fall on you or members of your family. Toppled furniture can also block exits and prevent you from escaping. Anchoring furniture so that it remains upright not only helps prevent injuries but also helps protect both the furniture and its contents.

Mitigation Opportunity

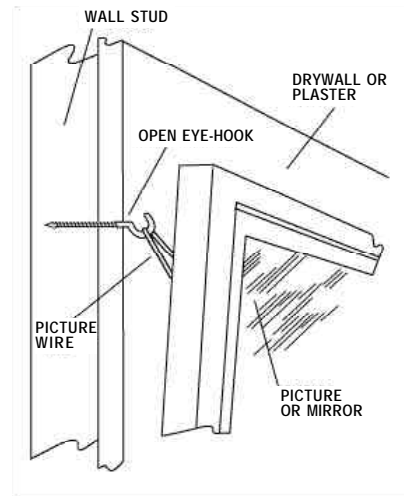
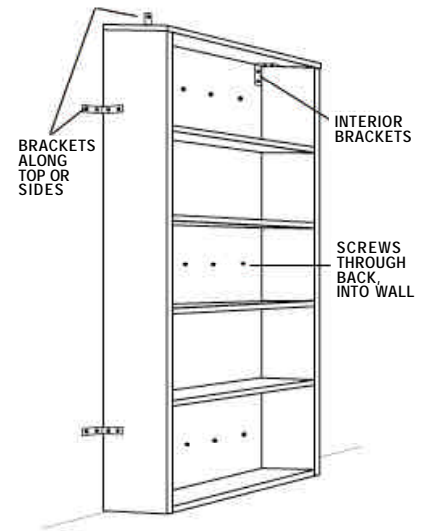
Many furnishings can be anchored, braced, or tethered to an adjacent wall to provide stability in an earthquake. First, locate the structural studs to see that they are near the items you want

anchored. If you have many items to anchor to a stud wall, it may be best to install a mounting strip so you avoid having to relocate items so they will line up with studs. A mounting strip is a horizontal piece of wood mounted to the wall and anchored to each stud. It may be constructed of structural-grade wood 2x4 or 2x6 or a continuous steel channel or angle. The mounting strip should be located at or near the top of the items you want to anchor.

You can anchor large pieces of furniture in several ways. Either bolt directly through the back of the furniture into the wall studs or use steel angle brackets. Do not use Gypsum board and most other interior wall coverings, which pull away easily from a wall. A toggle bolt or nail will also pull out during an earthquake and leave a hole in the wall. If essential contents are to be secured, the shelf or mounting surface should be secured prior to anchoring.

Attach a steel angle to wood studs using a minimum 1/4-inch-diameter by 3-inch lag bolt. Embed the bolt at least two inches into the wood stud. Attach steel angle to metal studs using #12 sheet-metal screws long enough to penetrate the flange material. Use two screws per connection, located 3 inches apart vertically.

For mounting strips, use #14 flat-head wood screws with countersunk heads, with at least 2 inches embedded into the wood stud behind the wall covering. Locate screws along the centerline of the 2x4 or 2x6, and anchor the strip to each stud with a maximum spacing of 24 inches on center. For attachments to the mounting strip, do not screw or bolt anything within 1 inch of each edge of a wood member.



Notes:



Earthquake - 310

Improve the securing of your wall sheathing

Everyone knows an earthquake can cause great damage. Many people, however, believe that an earthquake will never occur near them or it is unlikely to occur in their lifetime. These people who are not aware of their potential risk may do little to help themselves. Unfortunately, these people often suffer severe consequences from even a minor tremor.



Although no one can accurately predict where and when an earthquake will occur, there are certain areas where earthquakes are more likely to occur. Because these places may not have had earthquakes for a long time, homeowners develop a false sense of security, so the disaster catches them unprepared. There are some very simple precautions or mitigation measures that you can take to reduce your potential damage. You should do as much as possible to prevent and reduce your damage, inconvenience, and costs by using various mitigation measures.

Potential Hazard

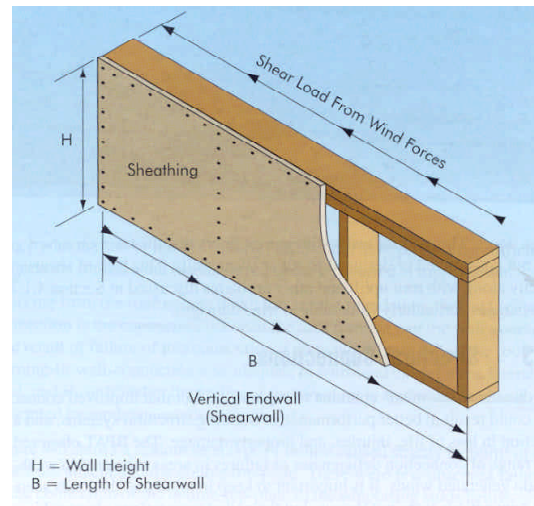
During an earthquake, building structures are distorted as they bend from side to side in response to the earthquake forces. For example, the top of a tall apartment building may lean



over a few feet in each direction. Building exterior walls are subject to horizontal forces. The building's shear walls absorb some of the loads imposed upon the building as a result of these distortions and transfer those loads to other members. If the shear wall cannot take the load, the wall may collapse. If not properly fastened to the structure of the building, the walls, interior and exterior, walls can fall down. Some homes do not have shear walls, which are typically sandwiched

Mitigation Measure

Notes:



Unit 3: Recognize the Risks and Mitigation Measures

Notes	Earthquake Exercise Sheet
Assess Earthquake Risk	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Earthquake Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	

Verify Mastery	Discuss responses.
----------------	--------------------

Unit 3: Recognize the Risks and Mitigation Measures

Earthquake Risk Pictures

(See following 8 pages)

Earthquake Risk No. 1



Earthquake Risk No. 2



Earthquake Risk No. 3



Earthquake Risk No. 4



Earthquake Risk No. 5



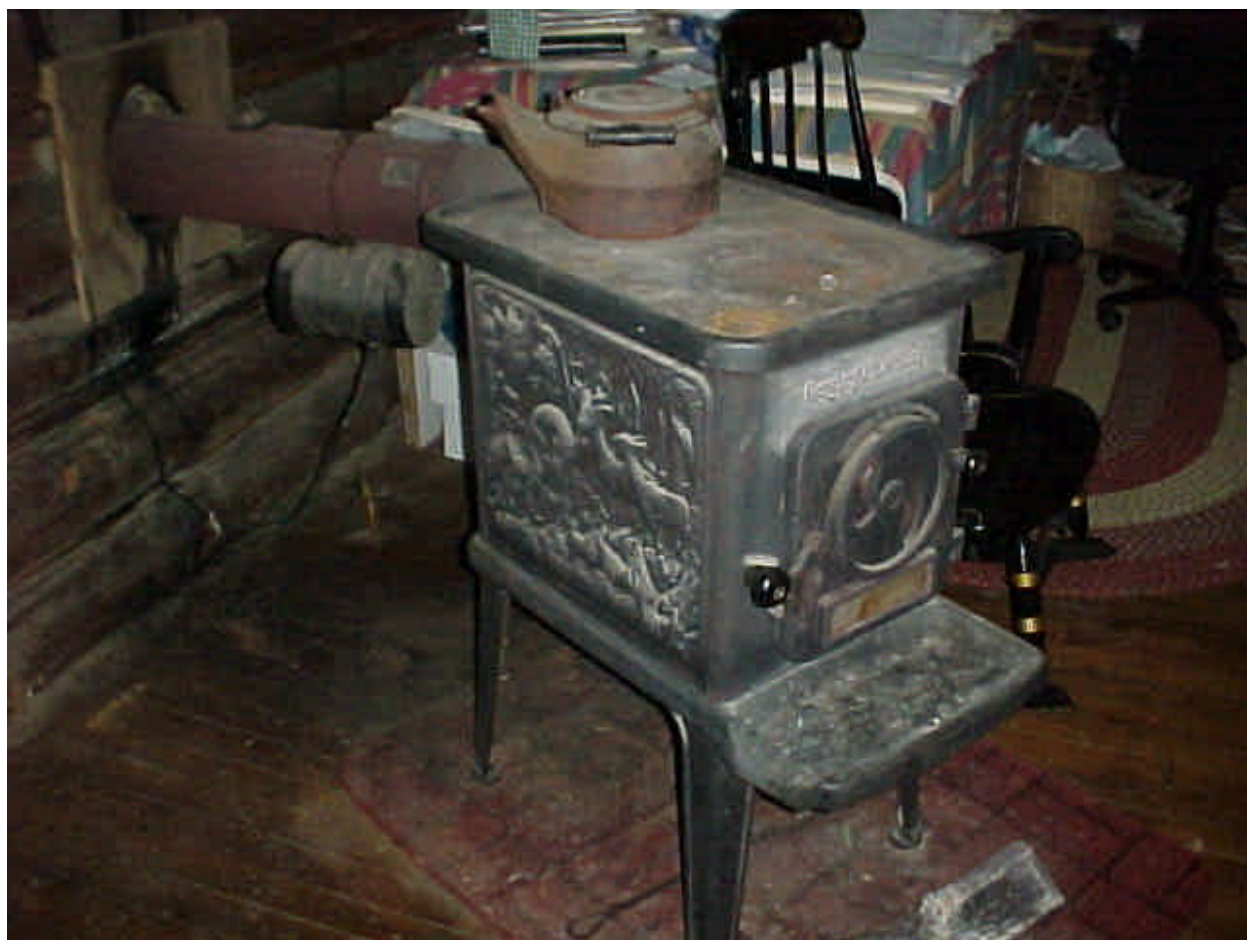
Earthquake Risk No. 6



Earthquake Risk No. 7



Earthquake Risk No. 8



Unit 3: Recognize the Risks and Mitigation Measures

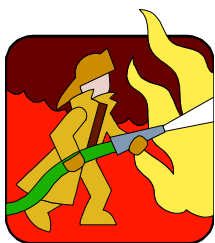
	Earthquake Exercise Sheet Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may necessarily be visible in the photo.

Earthquake Answer Sheet	
Picture Number	Action Checklist Number
1	301, 306, 308, 309
2	301, 303
3	(None really)
4	302
5	303, 308, 309
6	302, 309
7	301, 306, 308
8	309

Unit 3: Recognize the Risks and Mitigation Measures

Mitigation Fact Sheets – Wildfire

(See following 10 pages)



Fire - 401

Create a firebreak around your property

Every day Americans experience the tragedy of fire. Each year more than 4,500 Americans die in fires and more than 30,000 are injured. In fact, fires kill more Americans than all other natural disasters combined. Fortunately, unlike other disasters, most fire losses can be prevented through effective public education and awareness initiatives.



The risk of fire destroying homes and property increases in areas where wildlands and developed areas meet. More people are making their homes in woodland settings—in forests, rural areas or remote mountain sites. In areas where wildfires have occurred naturally for centuries, homes and gardens now add fuel that can accelerate the spread of fire. When wildfires occur today in these areas, limited resources often force fire fighters to choose between attacking the fire or defending a particular home. Manufactured homes, where death rates are twice as high as for other housing types, are of particular concern. Do not rely on luck—plan ahead.

Potential Hazard



Wildfires destroy hundreds of homes and acres of land every year. When the wind is blowing, a fire can spread very rapidly. If it is blowing strongly in the direction of your home, the fire could be fatal to you and your family. Having underbrush, dead leaves, or vegetation on the outside walls of your home increases your risk of losing your home. Recognizing these hazards is the first step toward making sure that they do not increase your risk of losing your life or home.

Mitigation Measure

Using fire-safe landscaping is an effective way to create an area of defensible space between your home and flammable

vegetation. Interrupting a fire's potential path is a first step to protecting your property and the area near your home.

Be sure to keep potential combustibles such as stacked firewood away from your home. If you live in a high-risk wildfire area, this small inconvenience is well worth the effort when compared to the increased safety it provides to your life and property.



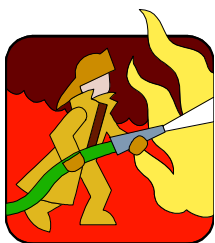
Experts say that if possible, you should keep a defensible space of at least 30' around your home cleared of vegetation. Hillsides are especially dangerous because they are very likely to catch gusts of wind. As a result, experts recommend that you clear a perimeter up to 100' for very steep hillsides. Also, remove vines from the sides of your home. Bare walls may not seem as pretty, but it is best to remove possible fuel from growing on your home. Keep your lawn trimmed and leaves raked, and keep your roof and rain-gutters free from debris like dead limbs and leaves.

Maintain a well-pruned and watered landscape to provide additional protection against fire. Shrubs should be pruned regularly. Remove small trees and plants growing under larger trees because they allow ground fires to jump into tree crowns. Space trees 30' apart, and prune them to a height of 8' to 10'. Pruning cuts should be clean and smooth; avoid flush cuts and stubs. Young, vigorous trees can withstand more severe pruning than older, weaker trees. Remove dead and diseased branches. To avoid stress to the tree, remove no more than one-third of its live foliage at one time.

The best time of the year to clean up the forest floor around your home is late fall after the leaves have fallen. This job does not require any special skills and should not take very long. This cleanup should be done every year. After the first cleanup of accumulated vegetation, the



job should require less time and effort. Where possible, you should promote the growth of fire-resistant plants and vegetation. Although no plant or tree is truly "fire-proof," some catch fire less readily than others.



Fire - 402

Relocate or protect your exterior fuel tanks

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Potential Hazard



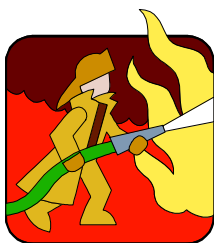
If a wildfire gets close to your home, it is very dangerous to have a large container of fuel near or attached to the outside of your house. Besides the possibility that the fuel may enlarge the fire already in progress, having a fuel tank nearby can make saving your home very difficult because no one can go near it. If a fuel tank gets hot enough to ignite, it can have the same effect as a small bomb going off.

Mitigation Measure

You should move the external fuel tank about 30 feet away from your home. Doing so may require using equipment powerful enough to

A photograph of a wooded area. In the foreground, there is a grassy clearing with some dry leaves and a small, bushy plant. In the background, there is a dense forest of tall trees, mostly without leaves, suggesting a late autumn or winter setting. The sky is visible through the tree canopy.

[illegible]



Fire - 403

Maintain your gutters & clear roof of debris

Every day Americans experience the tragedy of fire. Each year more than 4,500 Americans die in fires and more than 30,000 are injured. In fact, fires kill more Americans than all other natural disasters combined. Fortunately, unlike other disasters, most fire losses can be prevented through effective public education and awareness initiatives.



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Potential Hazard

Fires start easily and burn rapidly with light fuels like dry grasses and leaves, and then they ignite the homes nestled among them. Every year, wildfires destroy hundreds of homes across the country. In areas where wildlands



and developed properties are side by side, homes and other structures can become more fuel for fires. Dry leaves and twigs in your home's gutters may become added fuel to potential fires as well as interfere with their main purpose, to carry water away from your home.

Mitigation Measure

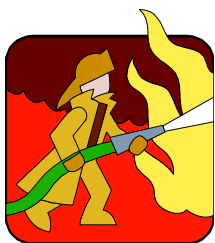
Denying fuel to a fire is one of the most successful ways of containing it and possibly saving your life and your home. If you live in a high fire hazard area, dead leaves and twigs need to be removed from your gutters and anywhere else on your roof where dead brush can accumulate. Many companies offer gutter cleaning services. The best time of the year to clean your gutters is in late autumn after the leaves have fallen. The cleanup should be done once a year. A crew of one or two people can clean your home's gutters in an hour or two.



One way to keep your roof clear of debris is to trim tree branches that overhang your home. Also, if there are dead or dying trees near or overhanging your home, you should have these trees removed.

Notes:

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.



Fire - 404

Cover openings with fine mesh

Every day Americans experience the tragedy of fire. Each year more than 4,500 Americans die in fires and more than 30,000 are injured. In fact, fires kill more Americans than all other natural disasters combined. Fortunately, unlike other disasters, most fire losses can be prevented through effective public education and awareness initiatives.



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Potential Hazard

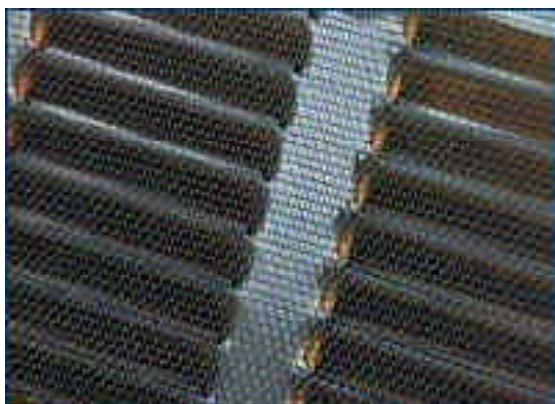


Fire needs fuel – something to burn, like grass, bushes, trees, or the homes nestled among them. Every year, wildfires destroy hundreds of homes and acres of land across the country. In areas where wildlands and developed properties are side by side, homes and other structures can become more fuel for fires. A slight breeze could carry burning cinders or sparks through any opening into your home. They can enter through even a small opening such as exterior venting, attic louvers, or the eaves. Sparks entering the house could set your house on fire.

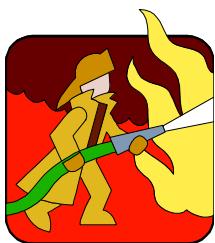
Mitigation Measure

Using a non-flammable fine wire mesh screen to cover the openings of your home will keep floating cinders or hot ash from entering and starting a fire. The reverse is also true; a fire that starts inside will be less likely to travel to the outside if openings are covered or protected by non-flammable wire mesh screens. This measure will help protect you and your family, your neighbors, and the environment.

All windows should have screens, and if you frequently leave your doors open, you should put screens on them, too. Screens are relatively easy to install, and even custom-made screens for irregular sized doors and windows are affordable.



Notes:



Fire - 405

Use fire resistant materials on your home

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Potential Hazard



When wildfires and brush fires spread to homes, it is often because burning branches, leaves, and other debris are lifted by the heated air and carried by the wind to roofs. Wood or asphalt shingles catch fire more easily than fire-resistant materials like slate, tile, and metal, which offer greater protection to your home. Although a distant wildfire is more likely to set your roof on fire than any other part of your house, it is also possible that hot cinders landing on the side of your home could set your home on fire.

Mitigation Measure

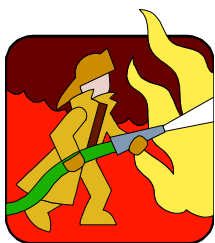
When you need to replace your roof, it is best to replace flammable roofing with fire-resistant materials such as slate, terra cotta or other types of tile, or standing-seam metal roofing. Although the fire-resistant materials are a little more expensive, you are also buying added protection against fire.

Slate and tile shingles generally are much heavier than asphalt or wood shingles. If you are considering switching to one of these heavier coverings, your roofing contractor should determine whether the framing of your home is strong enough to support them. If you live in an area where snow loads are a problem, consider switching to a modern standing-seam metal roof. Besides being fire resistant, it usually sheds snow efficiently.

If it is necessary to replace the wood siding on your house, you should use a non-flammable material like aluminum. Similarly, if you are replacing any doors and shutters, you should use aluminum or another metal. In addition, when you remodel your home, you should consider using fire resistant materials such as metal studs and fire resistant wall board.



Notes:



Fire - 406

Install Outdoor Spigots

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Potential Hazard

Whether a wildfire starts from natural causes, accidents, or carelessness, if it is near your home, it could quickly consume everything you own. If you act immediately, you may be able to bring a small fire under control and extinguish it. Having a source of water available outdoors can make a critical difference to whether your property can be saved.

Even if the fire is so far away that you cannot put it out, having an outside source of water is very advantageous. If you have enough warning, you can wet down the vegetation surrounding your home as well as your roof and siding. This action could lessen your damage from the wildfire. Also, if the wildfire is moving rapidly, wetting your home and property could protect your home long enough for the fire to pass or for firefighters to come to your assistance.

Homes that are in densely wooded areas or in areas with large amounts of underbrush are especially susceptible to wildfires.

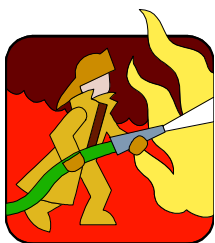
Mitigation Measure

If you live in an area at high risk from wildfires and your home does not have a spigot outdoors, you should install one. In fact, it is even better if your home has two outdoor spigots. With a spigot on both sides of your home, you can respond to a small fire emergency more quickly than if you had to use a hose attached to a spigot on the other side of your home. Having a second hose also provides you a greater capability to reach the places you want to wet down. Hoses should be equipped with nozzles in order to gain extra distance and ease in watering. Furthermore, having a nozzle makes it easier to reach the uppermost portions of your roof.



Of course, in the case of a large fire, if you are at all uncertain about whether the fire is controllable, you should evacuate the area and seek safety. If the authorities issue a general directive to evacuate an area, follow their instructions. Preserving your life and the lives of your loved ones is more important than anything else.

Notes:



Fire - 407

Install smoke & carbon monoxide detectors

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Potential Hazard



Smoke detectors are one of the most effective safety features you can install. If you have a fire, a working smoke detector can save your life and the lives of your loved ones. In fact, having a working smoke detector can double your chances of survival. A detector is the single most important means of preventing home fire fatalities by providing an early warning signal so you and your family can escape.



Mitigation Measure

Smoke detectors have saved thousands of lives, but homeowners do not always use them as effectively as they should. First, twelve percent of homes without detectors account for more than half of the fires. Second, it is estimated that one-third of the detectors in place are useless because they have a worn out battery; and third, smoke detectors in many homes are poorly located or there are not enough of them to protect the occupants properly.

Many hardware, home supply, or general merchandise stores carry smoke detectors. If you are unsure where to buy one in your community, call your local fire department (on a non-emergency telephone number) for suggestions.



The primary job of your smoke detector is to alert you to fires while you are asleep. Thus, your smoke detector should be located outside bedrooms or sleeping areas. In a multi-story home, a fire on a floor level without a smoke detector can grow to dangerous size before enough smoke rises in a stairway to set off a detector on an upper floor.

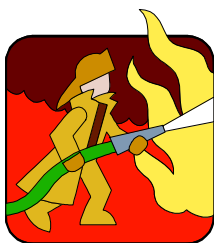


There are a few places where a smoke detector should not be placed. These include kitchens and garages because cooking fumes and car exhaust are likely to set them off, and unheated attics and crawl spaces because they can get too cold or hot for the electronics to work properly. Fires in these areas are generally detected by the other smoke detectors in enough time for you to escape safely. If you want a detector in these spaces, use a heat detector.

Remember that smoke detectors are the main safety devices in any home protection plan.

Smoke detectors are easy to install. In most cases, all you will need is a screw driver. Many brands are self-adhering and automatically stick to the wall or ceiling where they are placed. However, be sure to follow the directions from the manufacturer because each brand is different. If you are uncomfortable standing on a ladder, ask a relative or friend for help. Some fire departments will install a smoke detector in your home for you. Because smoke and many deadly gases rise, installing your smoke detectors at the proper level will provide you with the earliest warning possible.





Fire - 408

Provide fire extinguishers in your home

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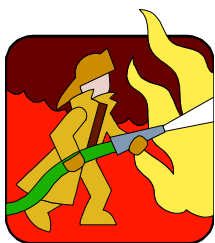


Potential Hazard

If you detect a small fire near your home, you may not have time to wait for the fire department to put out the fire. If you are lucky enough to catch a fire still in its formative stages, you may be able to put it out by yourself. However, the chance that a fire might be within reach of your garden hose is probably slim. The kitchen stove or space heaters may catch fire, or a cigarette or cigar could start a fire in any room in your house or outside your home.

Mitigation Measure

Having a wall mounted fire extinguisher will make it easier for you to put out a fire quickly. Fire extinguishers come in different sizes. Almost anyone can handle the smaller ones. Most adults can operate larger extinguishers. Be sure you and everyone in your family understands how to operate the extinguisher. Before you face a fire emergency, you should practice holding and aiming the extinguisher. Then, in case of a fire, you will know exactly what to do and be able to do it. While you are practicing, be sure you do not pull the trigger on the extinguisher and set it off. Also, have the pressure of the extinguisher checked to ensure the device continues to remain effective. Your local fire department can perform this service for you.



Fire - 409

Install a spark arrester in your chimney

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Potential Hazard

We've all seen sparks or red-hot ash fly out of chimneys at night. That hot ash or spark rising out of your chimney could land in dry foliage. If it is still hot, there is a chance that this spark could start a major fire that could endanger your home and the surrounding community.

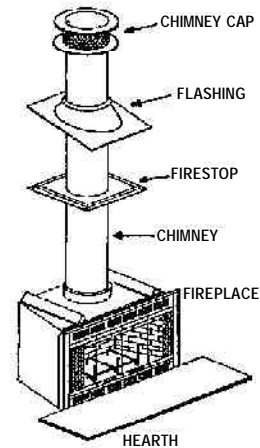


A fire is even more likely to start from a spark landing in a tree than on the ground for several reasons. Because the spark takes less time to go into a tree than to fall to the ground, it is more likely to be hot enough to catch fire. Also, a limb is exposed to breezes which can fan any smoldering sparks into a fire.

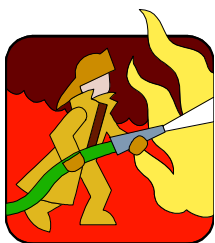
Mitigation Measure

Having either a chimney cap or a spark with wire mesh arrester on your chimney can keep hot particles from drifting out the top of your chimney and starting a fire. Although chimney caps keep rain from falling down the chimney, they do not keep sparks from escaping. Therefore, before you install a chimney cap, be sure it has a fine wire mesh between the cap and the chimney. Any chimney cleaning service can install a spark arrester, whether your chimney has a cap or not. A spark arrester is usually spring-loaded and fits into the top of the chimney. Many come with screws or bolts so you can anchor them to the inside wall of the chimney. A spark arrester should be inspected every five years to make sure it has not rusted.

Keep tree branches and limbs about 15' to 20' away from your chimney stack. It is best to hire a tree professional who knows how to trim the tree so that it does not become unbalanced in the process and create another hazard.



Notes:



Fire - 410

Keep your chimney clean

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Potential Hazard

Thick creosote build-up inside a chimney can ignite into an intense blaze. Chimney fires can cause flames or dense smoke to shoot from the top of the chimney. If a flaming spark or red-hot ash from your chimney lands on the ground or in a tree, it can start a fire there. Your chimney can turn into a flaming pillar that sets your home on fire. It might even burn explosively and set nearby property and homes on fire.

The experts say a regularly used chimney should be cleaned once a year. “Regular use” means as little as one cord of wood a year. A chimney needs regular cleaning because the creosote from the fires builds up on the inside of the chimney, and that area eventually becomes lacquered. This lacquer, when it is hot enough to flame, can be difficult to put out, especially when the fire is located in a hard to reach area.



Cleaning your chimney every year may save you the expense of hiring a professional chimney sweep. If your chimney has never been cleaned or has not been cleaned for a long time, it may require a professional cleaning.

[illegible]

Unit 3: Recognize the Risks and Mitigation Measures

Notes	Wildfire Exercise Sheet
Assess Fire Risk	Participants look at pictures of potential risks and identify the appropriate mitigation measures by putting the corresponding numbers from the Action Checklist on the answer sheet.

Wildfire Answer Sheet	
Picture Number	Action Checklist Number
1	
2	
3	
4	
5	
6	
7	
8	

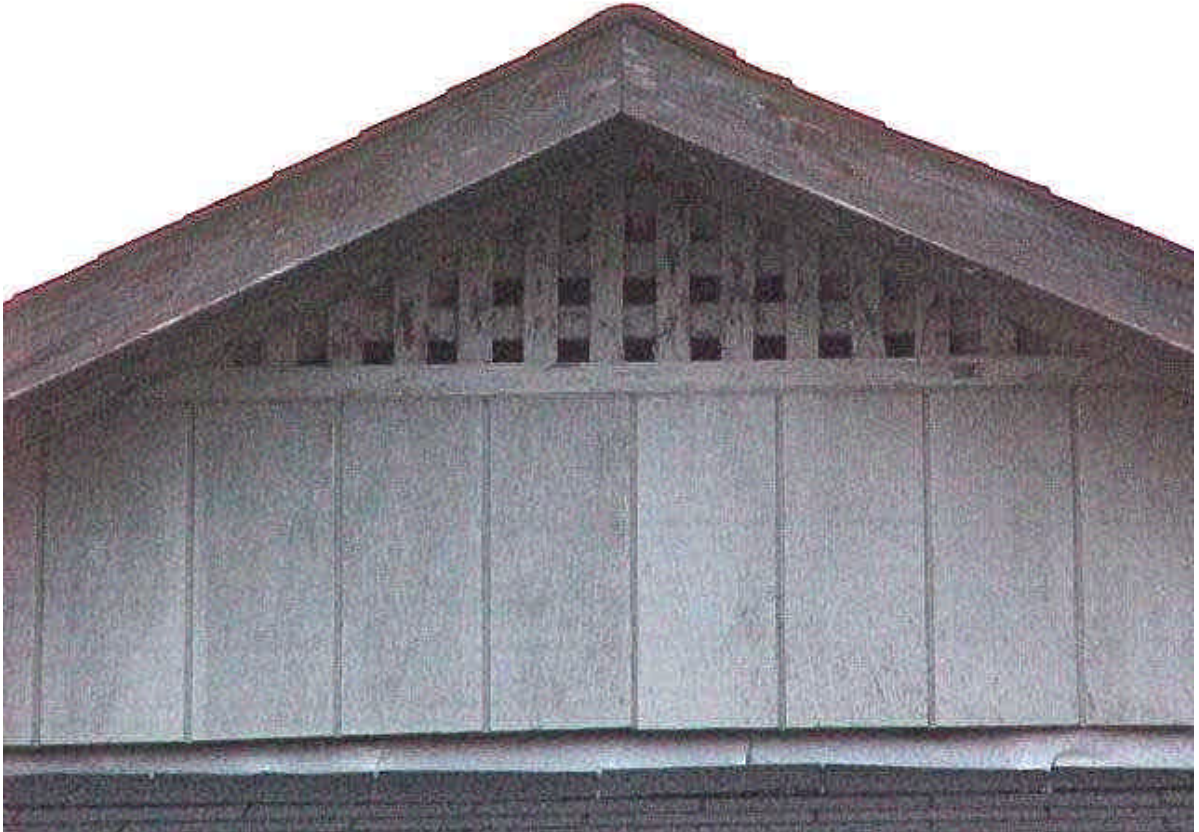
Verify Mastery	Discuss responses.
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Unit 3: Recognize the Risks and Mitigation Measures

Wildfire Risk Pictures

(See following 8 pages)

Wildfire Risk No. 1



Wildfire Risk No. 2



Wildfire Risk No. 3



Wildfire Risk No. 4



Wildfire Risk No. 5



Wildfire Risk No. 6



Wildfire Risk No. 7



Wildfire Risk No. 8



Unit 3: Recognize the Risks and Mitigation Measures

	Wildfire Exercise Sheet – Answer Key
	The answers below are only possible, not definite. Encourage participants to identify potential hidden risks that may necessarily be visible in the photo.

Wildfire Answer Sheet	
Picture Number	Action Checklist Number
1	403, 404, 405
2	401, 403, 404, 405, 406
3	401, 403, 404, 405, 406, 409, 410
4	401, 402
5	401, 403, 405, 409, 410
6	407, 408, 410
7	401, 402, 405, 406, 408
8	401, 403, 404, 405, 406

Choose Appropriate Mitigation Measures

Final Exercise

The following pictures show parts of properties which may or may not have potential risks from a disaster. First, decide what kind of risk you want to focus on: flood, wind, earthquake, or fire. Look carefully for every potential risk, then decide what mitigation measures are appropriate. Use the Action Checklist a reminder of what to look for. Use the following sheet to record your answers. Write the number of the picture that has the risk beside the mitigation measure.

For example, look at the picture below. What potential risks do you see from: Flood? Wind? Earthquake? Wildfire?



Unit 3: Recognize the Risks and Mitigation Measures

Final Review Answer Sheet

Directions: Put the picture number beside the number of the mitigation measure you recommend.

FLOOD

Mitigation Measure	Picture Number(s)
101	
102	
103	
104	
105	
106	
107	
108	
109	
110	

WIND

Mitigation Measure	Picture Number(s)
201	
202	
203	
204	
205	
206	
207	
208	
209	
210	

EARTHQUAKE

Mitigation Measure	Picture Number(s)
301	
302	
303	
304	
305	
306	
307	
308	
309	
310	

WILDFIRE

Mitigation Measure	Picture Number(s)
401	
402	
403	
404	
405	
406	
407	
408	
409	
410	

1





3





5





7









Unit 3: Recognize the Risks and Mitigation Measures

FLOOD

Mitigation Measure	Picture Number(s)
101	9
102	1, 2, 3, 4, 5, 8, 9
103	1, 4, 8
104	3, 4, 8, 9, 10
105	1, 2, 3, 4, 5, 8
106	2, 5, 7, 9
107	1, 2, 3, 4, 5, 7, 8
108	1, 2, 3, 5, 8
109	1, 2, 5, 9, 10
110	2, 10

WIND

Mitigation Measure	Picture Number(s)
201	1, 2, 3, 4, 5
202	2, 3, 4, 8
203	1, 2, 5, 7
204	5, 7
205	5, 7
206	1, 2, 3, 4, 5, 7, 8
207	2, 5, 7
208	2, 3, 4, 5, 6, 8
209	1, 2, 4, 5, 6, 10
210	5, 7

EARTHQUAKE

Mitigation Measure	Picture Number(s)
301	1, 2, 3, 4, 8, 9
302	2, 3, 4, 7, 8
303	1, 2, 5
304	5
305	5
306	3, 4, 8, 9
307	10
308	6, 10
309	9
310	2, 5

WILDFIRE

Mitigation Measure	Picture Number(s)
401	1, 2, 3, 4, 5, 8
402	4, 8, 9
403	1, 2, 4, 5, 8
404	1, 2, 4, 5, 6, 7
405	1, 2, 3, 4, 5, 7, 8
406	1, 2, 3, 4, 5, 8
407	6, 7
408	6, 7, 8, 10
409	5
410	5

Unit 3: Recognize the Risks and Mitigation Measures

Verify Understanding

Discuss participants' recommendations and reasons.

Ask for questions.

Unit 4: Integrate Costs, WAP, and Other Resources

**Recommended Total
Time: 2 hours**

Integrate Costs

In Unit 2 you determined the relative risks of flood, wind, earthquake and fire to four communities: Tulsa, OK; Kansas City, MO; Oakland / San Francisco, CA; and Wilmington, NC.

Review Unit 2 and 3
Overview of Unit 4
Time: 10 min.

You will use your Unit 2 conclusions shown in the Relative Risk Levels Table on page 4-8.

Unit 2: Risk Levels
Table

Unit 3: Hazards
Considered
Separately and
Measures Marked on
Action Checklist

In Unit 3 you identified various cost-effective mitigation measures that could be implemented at a selected property for each of the four selected natural disasters, with each considered separately. You marked all your desired mitigation measures on your Action Checklist. However, as the Relative Risk Level Table indicates, communities face multiple hazards at varying risk levels. Clearly, you need to focus on implementing mitigation measures that address the more serious hazards for your area and their associated risks.

The most important mitigation measures protect against risk: first to life, and then to property. To protect property, in general, emphasize enhancing the building integrity of the home. However, for fire, your priority concern is to keep the fire away from the home.

New Actions

In this unit you are going to perform several more actions and integrate their results into what you have already done. Then you will choose appropriate mitigation measures for the home:

- Consider the effects of costs on your recommendations
- Choose among mitigation measures when there are multiple hazards
- Integrate the WAP and this program

Get Cost Sheet

The Cost Sheets on pages 4-10 to 4-13 show the costs of implementing each mitigation measure on the Action Checklist. You need to make sure the cost of implementing your recommendations for each home does not exceed the budgeted amount according to the program implemented in your region.

Unit 4: Integrate Costs, WAP, and Other Resources

You should factor in the availability of resources available from other programs and sources.

Cross-hazard benefits When there are multiple hazards, there may be crossover benefits from some mitigation measures that particularly enhance their benefit to the homeowner.

For example, the Sanders Valve protects both life and property from flood and earthquake risks.

Effects of WAP and other resources You also need to consider the effects of your WAP recommendations and their costs for additional crossover benefits.

For example, if the windows are reinforced under the WAP, you might use the Hazard Identification and Mitigation program to add shutters in preference to another possible mitigation measure. Or, if the WAP can fund part of the cost of clearing vegetation, this program could fund the rest.

Also consider what other available resources could benefit this homeowner and family. Consider how you might combine all resources to provide the greatest possible benefits.

In the following practice exercises, you will consider which mitigation measures to implement for the same home located first in Tulsa, OK; then in Kansas City, MO; then San Francisco/Oakland, CA; and last, in Wilmington, NC.

Note: This is not like in the field, where you will be in just one geographical area, but this way is most adaptable for our classroom exercise.

Use the Action Checklist with your marked recommendations on page 3-2.

Guided Practice Determine your recommended mitigation measures.

Critical Steps in the Process The critical steps for figuring out which mitigation measures to recommend for a particular home are:

1. Identify the relative risks to your locality for each natural hazard. (Tools are available from FEMA, such as a FIRM for flooding and a wind map; the USGS for maps for earthquake risk, and the National Wildland/Urban Interface Fire Protection Program for a Peak Fire Seasons map.)

Unit 4: Integrate Costs, WAP, and Other Resources

2. Focus your assessment on the hazards that offer the highest relative risks to your area.
3. Identify appropriate mitigation measures for the home you are inspecting. Mark all your identified mitigation measures on the Action Checklist.
4. Consider the impact of local codes on your choices.
5. Consider the possibility of using other funds and programs to supplement this program.
6. Use the Cost Sheet to determine the cost of implementing those mitigation measures.
7. Consider the effect of the WAP on your choices.
8. Decide which measures on the Action Checklist have the greatest effectiveness.
9. Talk to the homeowner. As you leave, express your thanks for allowing your visit.

Time: 30 min.

Determine Costs

Verify Understanding

For our exercises, you will be limited to spending \$800 on this home.

Note: The actual limit or guide for the program implementation in your region may vary.

Refer to the Relative Risk Levels from Selected Natural Disasters table on page 4-8 for the following questions.

For Tulsa, OK

Ask:

1. Which relative risks are highest for Tulsa?

On your Action Checklist for all the measures you checked:

(To save time, omit 2, 3 and discussion, however at least two scenarios should be costed.)

2. Determine the cost of implementing each by referring to the Cost Sheet and including any donated services/materials.
3. Does the total cost exceed your budget for this program?

Unit 4: Integrate Costs, WAP, and Other Resources

Discussion	<ul style="list-style-type: none">• Discuss relative merits of various measures participants have recommended.• Suggest the Inspector might want to spend more on a home. What justification should be provided to the Supervisor?
For Kansas City, MO	Ask: 4. Which relative risks are highest for Kansas City? On your Action Checklist for the measures you checked: (To save time, omit 5, 6 and discussion, however at least two scenarios should be costed.) 5. Determine the cost of implementing each by referring to the Cost Sheet and including any donated services/materials. 6. Does the total cost exceed your budget?
Questions/Discussion	Encourage questions and have participants explain their reasoning.
For San Francisco / Oakland, CA	Ask: 7. Which relative risks are highest for SF/Oakland? On your Action Checklist for the measures you checked: (To save time, omit 8, 9 and discussion, however at least two scenarios should be costed.) 8. Determine the cost of implementing each by referring to the Cost Sheet and including any donated services/materials. 9. Does the total cost exceed your budget?
Questions/Discussion	Encourage questions and have participants explain their reasoning.
For Wilmington, NC	Ask: 10. How will you determine where to concentrate your recommendations when the relative risk rankings are very similar? For example, The Relative Risk Levels Table shows Wilmington, NC has medium risk for flood; medium high risk for wind; low medium risk for earthquake; and medium risk for fire.
<i>When risk rankings are similar the inspector should select mitigation measures that can be combined or installed at the same time.</i>	
Final Practice Exercise	On your Action Checklist for the measures you checked:

Unit 4: Integrate Costs, WAP, and Other Resources

11. Determine the cost of implementing each by referring to the Cost Sheet and including any donated services/materials.
12. Does the total cost exceed your budget?

Unit 4: Integrate Costs, WAP, and Other Resources

Time: 30 min.

Integrate the WAP Recommendations and Other Programs; Consider Relative Benefits

In Unit 3: The Exercise House has many measures checked for every hazard, narrow the number to two in each. The situation for each home is different and determined only by an inspection, so this limitation of the problem is realistic.

Integration with WAP Consider the effects of the WAP on your recommendations.

Refer to kinds of work performed under WAP

Consider how work done under other program resources and how the WAP and this HI & M program may have related aspects. Therefore, when work is being done under one program, another governmental program's resources and other private sources might also be used to greatest advantage to the homeowner.

For example, when the WAP work is for roofing, appropriate mitigation measures under Hazard Identification and Mitigation might include:

- 204: Increase end gable fastening/bracing
- 205: Replace gable vent with slotted or power vent
- 206: Fasten roof to walls as feasible
- 207: Improve securing of roof sheathing
- 404: Cover windows, vents and skylights with non-flammable ½" screening mesh
- 405: Use fire resistant construction materials for repairs/modifications to property

Discussion

- Ask participants to provide other examples.
- Discuss participants' responses and their reasoning.

Time: 10 min.

Make Final Decision

- Consider various combinations of how to use all available resources most effectively for the homeowner.
- Decide which measures on the Action Checklist have the greatest benefit. Circle them.

Unit 4: Integrate Costs, WAP, and Other Resources

Application Exercises	What mitigation measures and why would you recommend for the home in A. Tulsa? B. Kansas City? C. San Francisco / Oakland? D. Wilmington?
Final Questions	Ask if participants are ready for a final exercise. Respond to questions.
Verify Understanding	Directions: Change the data for Wilmington, NC, so the risk from flooding is high. Keep all other risk information the same.
Final Exercise	What mitigation measures will you recommend for this home?
Time: 20 min.	Why?
Discussion of the Recommendations Time: 10 min.	Ask what recommendations were recommended and why. Discuss any variations in responses.
Close Time: 10 min.	<ul style="list-style-type: none">• Thank participants for their contributions.• Ask them to complete the evaluation sheet.

Unit 4: Integrate Costs, WAP, and Other Resources

Relative Risk Levels from Selected Natural Disasters				
	Tulsa, OK	Kansas City, MO	San Francisco / Oakland, CA	Wilmington, NC
Risk from:				
Flood*	Low	High	Low	Medium
Wind	High	High	Low	Medium High
Earthquake	Low	Low	High	Low Medium
Fire	Medium	Medium	Low	Medium

* The risk due to flooding varies from structure to structure and is determined by the depth of flooding in the structure.

Unit 4: Integrate Costs, WAP, and Other Resources

Participant Work Sheet

Unit 4: Integrate Costs, WAP, and Other Resources

Cost Sheets – Estimates for the Fact Sheet mitigation measures.

Material costs were developed using RS Means and estimates from selected home improvement stores. Labor costs were estimated based on a ratio to material cost of 1:1 that is used for WAP. In unique situations where machinery and crew labor is required a greater multiplier times materials was utilized.

FLOOD

Mitigation Measure	Description of Mitigation Measure	Estimated Cost		
		Materials	Labor	Total
101	Install gasketed well head cover with bolts	\$100-\$150	\$100-\$150	\$200-\$300
102	Clean gutters and storm drains and purchase and install gutter guard	\$35-\$50	\$70-\$100	\$100-\$150
103	Install gas safety cut-off valve to interior gas line	\$200-\$250	\$150-\$250	\$350-\$500
104	Anchor/elevate external fuel and Air Conditioning units	\$300-\$400	\$300-\$400	\$600-\$800
105	Anchor homes to foundation	\$80-\$100	\$160-\$200	\$240-\$300
106	Apply protective sealants to exterior and below-grade walls	Sealant \$700-\$800 for 240 sq. ft. Metal flood shields \$73 per sq. ft. Wood shields \$23 per sq. ft.	\$100-\$800	\$200-\$1,600
107	Buy and install septic backflow valve	\$100-300	\$300-\$900	\$400-\$1,200
108	Buy and install floating drain plug in first floor	\$30-\$40	\$60-\$80	\$90-\$120
109	Build interior walls around critical utilities	3-ft. high wall with a 35-ft. perimeter \$300-\$500; Submersible pump \$60-\$100	\$200-\$500	\$300-\$1,000
110	Move internal utilities/appliances to another floor or elevate in-place requiring an electrician and laborers for the heavy lifting	\$50-\$140	\$500-\$1,000	\$600-\$1,100

Unit 4: Integrate Costs, WAP, and Other Resources

WIND

Mitigation Measure	Description of Mitigation Measure	Estimated Cost		
		Materials	Labor	Total
201	Trim, prune, and/or remove tree limbs and whole trees [Reduce potential for flying debris (i.e., anchor sheds, equipment, and miscellaneous materials)]	No materials needed-only tree professional service	\$300-\$500	\$300-\$500
202	Buy and install galvanized metal plating or strapping to secure home to foundation	\$5.00-\$7.00 for 50 ft. (\$250-\$300)	\$250-\$300	\$500-\$600
203	Uncover wall framing in order to screw or otherwise attach frame to foundation of regular or non-manufactured homes	\$125-\$175	\$250-\$350	\$375-\$525
204	Install 2x4s to brace end gables, galvanized fasteners to further secure the gables, and 16d nails or screws	\$30-\$40	\$45-\$60	\$75-\$100
205	Install slotted or power vents to replace older gable vents	\$150-\$200	\$150-\$200	\$300-\$400
206	Install hurricane straps in order to fasten the roof to the home walls	\$40-\$120	\$100-\$300	\$140-\$420
207	Install 16d nails to improve securing of sheathing to roof. High-strength adhesive AFG01	\$30-\$50	\$100-\$200	\$130-\$250
208	Add or replace door bolts and add or replace door hinges Apply impact resistant safety film to windows.	Door- \$10 to \$40; Adding safety coating to glass: \$5.00 per sq. ft.	Door- \$10-\$40; Safety Film- \$100-\$200	\$20-\$300
209	Create a safe area within your home to protect people	\$250-\$500	\$250-\$500	\$500-\$1,000
210	Install 2x4s to brace trusses of A frame homes	\$40-\$50	\$60-\$75	\$100-\$125

EARTHQUAKE

Mitigation Measure	Description of Mitigation Measure	Estimated Cost		
		Materials	Labor	Total
301	Install gas safety cut-off valve to interior gas line	\$200-\$250	\$150-\$250	\$350-\$500
302	Install bracing for a manufactured home	\$5.00-\$7.00 for 50 ft. (\$250-\$300)	\$250-\$300	\$500-\$600
303	Install metal plates and bolt to connect house sill plate to foundation	\$125-\$225	\$250-\$450	\$375-\$675
304	Brace cripple walls with rebar and grout for masonry units and extra courses of brick?	\$200-\$350	\$400-\$700	\$600-\$1,050
305	Install steel straps and angle bracing to go around chimneys and bolt the non free standing straps to the exterior walls	\$500-\$800	\$500-\$800	\$1,000-\$1,600
306	Install flexible piping for appliances and utilities. Buy and install angle bracing for overhead pipes	\$75-\$300	\$50-\$100	\$125-\$400
307	Install steel straps to strap the water heater to wall studs or concrete anchors for masonry walls.	\$80-\$100	\$80-\$100	\$160-\$200
308	Install lengths of heavy to medium strength chains and bolt them around propane type fuel tanks, or buy lightweight chains for counter top appliances or TVs, or buy steel straps to anchor wood stove flues and bolts to bolt wood stoves to the floor	\$20-\$50	\$20-\$50	\$40-\$100
309	Install bolts and brackets to bolt down bookcases and steel bands to keep shelf contents from sliding off	\$5-\$15	\$10-\$30	\$15-\$45
310	Improve or secure wall sheathing	\$125-\$175	\$250-\$350	\$375-\$525

Unit 4: Integrate Costs, WAP, and Other Resources

FIRE

Mitigation Measure	Description of Mitigation Measure	Materials	Estimated Cost Labor	Total
401	Hire two landscape professionals for removing vines from walls and creating a zone around the home free of underbrush and dead leaves	N/A	\$100-\$150	\$100-\$150
402	Relocate/Protect exterior, above-ground fuel tank(s) and reconnect the service lines	\$100-\$150	\$300-\$450	\$400-\$600
403	Maintain gutters, eaves, and clear roof of leaves and woody debris	N/A	\$70-\$100	\$70-\$100
404	Install non-flammable, or replace flammable, window and door screens with ½-inch or less screening mesh	\$25 for windows, \$75 for doors,	\$50-\$75	\$70-\$150
405	Replace existing roofing material with tile, metal, or slate roofing (cost are averages based upon roof area and are all inclusive)			\$4 per square foot for tile or metal roofing, \$7 per square foot for slate
406	Spigot and 10 ft. Copper piping Nozzle and 100 ft. Hose	\$40-\$50	\$80-\$120	\$120-\$170
407	Buy and install smoke and carbon monoxide detectors; to hard wire one in-place, an electrician is needed	\$5-\$40	\$25-\$50	\$30-\$90
408	Install 1 fire extinguisher	\$20-\$60	\$10-\$15	\$30-\$75
409	Install a chimney spark arrester, hire a tree professional to trim/cut tree limbs and branches to keep them a safe distance from the chimney opening	\$30-\$50	\$50-\$150	\$80-\$200
410	Clean chimney (only the service required)	N/A	\$60-\$65 brush, \$250 -\$500 mechanical cleaning	\$60-\$500

Appendix

Table of Contents

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Appendix C : References _____ 5-7

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Appendix E : Instructor Information _____ 5-20

Appendix F : Flood Insurance Documentation

National Flood Insurance Program Fact Sheet _____ 5-23

National Flood Insurance Program Website Cost Information _____

Flood Insurance Slide Show

Flood Insurance Rate Maps _____ plastic pouch

FEMA Guide to Flood Insurance Rate Maps _____ plastic pouch

Appendix G : Case Studies

Case Study 1 – Manufactured Home

Case Study 2 – Single Family Home

Action Checklist

Name _____

Job # _____

Address _____

Date _____

Inspector _____

100.

- 101. Retrofit your well to reduce contamination ☐
- 102. Maintain storm drains on your property ☐
- 103. Install a gas safety cut-off valve ☐
- 104. Anchor and elevate fuel tanks & AC units ☐
- 105. Anchor your home ☐



FLOOD

- 106. Apply protective sealant to your walls ☐
- 107. Install a septic backflow preventer ☐
- 108. Consider wetproofing options ☐
- 109. Install interior or exterior flood walls ☐
- 110. Relocate or elevate internal appliances ☐

200.

- 201. Reduce potential for flying debris ☐
- 202. Anchor the base of your manufactured home ☐
- 203. Bolt your house sill plate connection ☐
- 204. Increase your gable end bracing ☐
- 205. Replace gable vent with slotted vent ☐



WIND

- 206. Fasten your roof & walls - hurricane straps ☐
- 207. Improve the securing of your roof sheathing ☐
- 208. Improve closure of your windows and doors ☐
- 209. Create a safe area in your home ☐
- 210. Improve the bracing of your "A" frame roof ☐

300.

- 301. Install a gas safety cut-off valve ☐
- 302. Brace your manufactured home ☐
- 303. Bolt your house sill plate connection ☐
- 304. Brace your cripple walls ☐
- 305. Brace your masonry chimney ☐



EARTHQUAKE

- 306. Use flexible connections for gas and water ☐
- 307. Strap your water heater ☐
- 308. Secure your light home contents ☐
- 309. Secure your furniture ☐
- 310. Improve the securing of your wall sheathing ☐

400.

- 401. Create a firebreak around your property ☐
- 402. Relocate or protect your exterior fuel tanks ☐
- 403. Maintain your gutters & clear roof of debris ☐
- 404. Cover openings with fine mesh ☐
- 405. Use fire resistant materials on your home ☐



FIRE

- 406. Install outside spigots ☐
- 407. Install smoke & carbon monoxide detectors ☐
- 408. Provide fire extinguishers in your home ☐
- 409. Install a spark arrester on your chimney ☐
- 410. Keep your chimney clean ☐

Notes: _____

Action Checklist

Name _____

Job # _____

Address _____

Date _____

Inspector _____

100.

- 101. Retrofit your well to reduce contamination ☐
- 102. Maintain storm drains on your property ☐
- 103. Install a gas safety cut-off valve ☐
- 104. Anchor and elevate fuel tanks & AC units ☐
- 105. Anchor your home ☐



FLOOD

- 106. Apply protective sealant to your walls ☐
- 107. Install a septic backflow preventer ☐
- 108. Consider wetproofing options ☐
- 109. Install interior or exterior flood walls ☐
- 110. Relocate or elevate internal appliances ☐

200.

- 201. Reduce potential for flying debris ☐
- 202. Anchor the base of your manufactured home ☐
- 203. Bolt your house sill plate connection ☐
- 204. Increase your gable end bracing ☐
- 205. Replace gable vent with slotted vent ☐



WIND

- 206. Fasten your roof & walls - hurricane straps ☐
- 207. Improve the securing of your roof sheathing ☐
- 208. Improve closure of your windows and doors ☐
- 209. Create a safe area in your home ☐
- 210. Improve the bracing of your "A" frame roof ☐

300.

- 301. Install a gas safety cut-off valve ☐
- 302. Brace your manufactured home ☐
- 303. Bolt your house sill plate connection ☐
- 304. Brace your cripple walls ☐
- 305. Brace your masonry chimney ☐



EARTHQUAKE

- 306. Use flexible connections for gas and water ☐
- 307. Strap your water heater ☐
- 308. Secure your light home contents ☐
- 309. Secure your furniture ☐
- 310. Improve the securing of your wall sheathing ☐

400.

- 401. Create a firebreak around your property ☐
- 402. Relocate or protect your exterior fuel tanks ☐
- 403. Maintain your gutters & clear roof of debris ☐
- 404. Cover openings with fine mesh ☐
- 405. Use fire resistant materials on your home ☐



FIRE

- 406. Install outside spigots ☐
- 407. Install smoke & carbon monoxide detectors ☐
- 408. Provide fire extinguishers in your home ☐
- 409. Install a spark arrester on your chimney ☐
- 410. Keep your chimney clean ☐

Notes: _____

Appendix B : Cost Estimates for the Fact Sheet mitigation measures

Material costs were developed using RS Means and estimates from selected home improvement stores. Labor costs were estimated based on a ratio to material cost of 1:1 that is used for WAP. In unique situations where machinery and crew labor is required a greater multiplier times materials was utilized.

FLOOD

Mitigation Measure	Description of Mitigation Measure	Estimated Cost		
		Materials	Labor	Total
101	Install gasketed well head cover with bolts	\$100-\$150	\$100-\$150	\$200-\$300
102	Clean gutters and storm drains and purchase and install gutter guard	\$35-\$50	\$70-\$100	\$100-\$150
103	Install gas safety cut-off valve to interior gas line	\$200-\$250	\$150-\$250	\$350-\$500
104	Anchor/elevate external fuel and Air Conditioning units	\$300-\$400	\$300-\$400	\$600-\$800
105	Anchor homes to foundation	\$80-\$100	\$160-\$200	\$240-\$300
106	Apply protective sealants to exterior and below-grade walls	Sealant \$700-\$800 for 240 sq. ft. Metal flood shields \$73 per sq. ft. Wood shields \$23 per sq. ft.	\$100-\$800	\$200-\$1,600
107	Buy and install septic backflow valve	\$100-\$300	\$300-\$900	\$400-\$1,200
108	Buy and install floating drain plug in first floor	\$30-\$40	\$60-\$80	\$90-\$120
109	Build interior walls around critical utilities	3-ft. high wall with a 35-ft. perimeter \$300-\$500; Submersible pump \$60-\$100	\$200-\$500	\$300-\$1,000
110	Move internal utilities/appliances to another floor or elevate in-place requiring an electrician and laborers for the heavy lifting	\$50-\$140	\$500-\$1,000	\$600-\$1,100

WIND

Mitigation Measure	Description of Mitigation Measure	Estimated Cost		
		Materials	Labor	Total
201	Trim, prune, and/or remove tree limbs and whole trees [Reduce potential for flying debris (i.e., anchor sheds, equipment, and miscellaneous materials)]	No materials needed-only tree professional service	\$300-\$500	\$300-\$500
202	Buy and install galvanized metal plating or strapping to secure home to foundation	\$5.00-\$7.00 for 50 ft. (\$250-\$300)	\$250-\$300	\$500-\$600
203	Uncover wall framing in order to screw or otherwise attach frame to foundation of regular or non-manufactured homes	\$125-\$175	\$250-\$350	\$375-\$525
204	Install 2x4s to brace end gables, galvanized fasteners to further secure the gables, and 16d nails or screws	\$30-\$40	\$45-\$60	\$75-\$100
205	Install slotted or power vents to replace older gable vents	\$150-\$200	\$150-\$200	\$300-\$400
206	Install hurricane straps in order to fasten the roof to the home walls	\$40-\$120	\$100-\$300	\$140-\$420
207	Install 16d nails to improve securing of sheathing to roof. High-strength adhesive AFG01	\$30-\$50	\$100-\$200	\$130-\$250
208	Add or replace door bolts and add or replace door hinges Apply impact resistant safety film to windows.	Door-\$10 to \$40; Adding safety coating to glass: \$5.00 per sq. ft.	Door-\$10-\$40; Safety Film-\$100-\$200	\$20-\$300
209	Create a safe area within your home to protect people	\$250-\$500	\$250-\$500	\$500-\$1,000
210	Install 2x4s to brace trusses of A frame homes	\$40-\$50	\$60-\$75	\$100-\$125

EARTHQUAKE

Mitigation Measure	Description of Mitigation Measure	Estimated Cost		
		Materials	Labor	Total
301	Install gas safety cut-off valve to interior gas line	\$200-\$250	\$150-\$250	\$350-\$500
302	Install bracing for a manufactured home	\$5.00-\$7.00 for 50 ft. (\$250-\$300)	\$250-\$300	\$500-\$600
303	Install metal plates and bolt to connect house sill plate to foundation	\$125-\$225	\$250-\$450	\$375-\$675
304	Brace cripple walls with rebar and grout for masonry units and extra courses of brick?	\$200-\$350	\$400-\$700	\$600-\$1,050
305	Install steel straps and angle bracing to go around chimneys and bolt the non free standing straps to the exterior walls	\$500-\$800	\$500-\$800	\$1,000-\$1,600
306	Install flexible piping for appliances and utilities. Buy and install angle bracing for overhead pipes	\$75-\$300	\$50-\$100	\$125-\$400
307	Install steel straps to strap the water heater to wall studs or concrete anchors for masonry walls.	\$80-\$100	\$80-\$100	\$160-\$200
308	Install lengths of heavy to medium strength chains and bolt them around propane type fuel tanks, or buy lightweight chains for counter top appliances or TVs, or buy steel straps to anchor wood stove flues and bolts to bolt wood stoves to the floor	\$20-\$50	\$20-\$50	\$40-\$100
309	Install bolts and brackets to bolt down bookcases and steel bands to keep shelf contents from sliding off	\$5-\$15	\$10-\$30	\$15-\$45
310	Improve or secure wall sheathing	\$125-\$175	\$250-\$350	\$375-\$525

FIRE

Mitigation Measure	Description of Mitigation Measure	Estimated Cost		
		Materials	Labor	Total
401	Hire two landscape professionals for removing vines from walls and creating a zone around the home free of underbrush and dead leaves	N/A	\$100-\$150	\$100-\$150
402	Relocate/Protect exterior, above-ground fuel tank(s) and reconnect the service lines	\$100-\$150	\$300-\$450	\$400-\$600
403	Maintain gutters, eaves, and clear roof of leaves and woody debris	N/A	\$70-\$100	\$70-\$100
404	Install non-flammable, or replace flammable, window and door screens with ½-inch or less screening mesh	\$25 for windows, \$75 for doors,	\$50-\$75	\$70-\$150
405	Replace existing roofing material with tile, metal, or slate roofing (cost are averages based upon roof area and are all inclusive)			\$4 per square foot for tile or metal roofing, \$7 per square foot for slate
406	Spigot and 10 ft. Copper piping Nozzle and 100 ft. Hose	\$40-\$50	\$80-\$120	\$120-\$170
407	Buy and install smoke and carbon monoxide detectors; to hard wire one in-place, an electrician is needed	\$5-\$40	\$25-\$50	\$30-\$90
408	Install 1 fire extinguisher	\$20-\$60	\$10-\$15	\$30-\$75
409	Install a chimney spark arrester, hire a tree professional to trim/cut tree limbs and branches to keep them a safe distance from the chimney opening	\$30-\$50	\$50-\$150	\$80-\$200
410	Clean chimney (only the service required)	N/A	\$60-\$65 brush cleaning, \$250 -\$500 mechanical cleaning	\$60-\$500

Appendix C : References

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Seismic Retrofit Training for Building Contractors & Inspectors: ideas, text, pictures, cost, suggested funding agencies for earthquake related mitigation

Money for Mitigating Earthquake Hazards

Map of USGS Earthquake Zones take from...

[URL:http://www.geohazards.cr.usgs.gov/eq/graphics/usmap.pdf](http://www.geohazards.cr.usgs.gov/eq/graphics/usmap.pdf)

For information about your specific locality, see also:

- Interactive Maps
- Hazard by Zip Code

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Appendix D: Unit Questions and Answers

Unit 2: Identify the Hazards

1. What does darker shading indicate?
 - A. Greater risk
2. On the top map, what do the numbers in the middle of the blocks mean?
 - A. They indicate the panel that shows detail of that area.

Identify on Pp. 10-11:

3. The meaning of the numbers “8, 9, and 10” beside the wavy lines
 - A. They indicate the base flood elevation level in feet at the marked areas. Because the elevation varies along the watercourse, each number beside a wavy line is an interpolation from the cross section readings, not a directly measured reading.
4. The areas:
 - A. At greatest risk - those with darker shading, especially Zones AE, the floodway and between EL 8 and EL 9, and VE, EL 9
 - B. At less risk - The lighter tinted areas: Zone X
 - C. At minimal risk - Zone X unshaded
 - D. At unknown risk - Tricky question because Zone D is not shown on this map; however, Zone X unshaded is also unknown because the map does not indicate land contours.
5. The meaning of the hatched lines in the Hackberry Draw and the consequences for a resident whose home is there
 - A. The hatched lines (P. 14) mean the home is in the floodway area, so the home is at high risk of flooding or severe damage.
6. The risk to Zone X areas at the top left which are untinted vs. those also in Zone X which are tinted
 - A. The risk to the untinted zone is indeterminate because the map does not show land contours; the tinted zone is in the 500-year floodplain, or the 100-year floodplain with risk of flooding up to a foot, or an area protected by a levee.
7. A Coastal Barrier area
 - A. Zone VE (bottom center) with the cross-hatching.
8. The risk associated with the area left of the marked “Limit of Floodway”
 - A. It is marked Zone AE, EL 8, so the risk to 8 feet elevation is high.

Unit 2: Identify the Hazards - Continued

9. How do you get a FIRM?
 - A. P. 2: You can look at a map at your local community map repository site, such as your local planning, zoning or engineering office. You can also order a FIRM from FEMA. (P. 20 explains the procedures.)
10. Is a FIRM free?
 - A. P. 20 No, there is a nominal fee.
11. If you want flood risk information for a large city or county, how many maps will you need? How can you find out?
 - A. P. 20 Review the current Flood Map on file at your local community map repository; request from FEMA a copy of the Flood Map index to identify the panels you need.
12. What is the date of the map's information?
 - A. 1998
13. What does the 6-digit number "370168" signify?
 - A. The community's number
14. What do the numbers after that 6-digit number signify?
 - A. The panel number
15. What number do you need for the map showing Routes 40 and 17, the Murrayville and Kings Grant Tributaries and Pages Creek?
 - A. 370168 0045 E
16. What is its date?
 - A. 1992
17. Is the NFIP available for residents in this area?
 - A. At the bottom of each FIRM is information about how to find out if this program is available in this community.
18. For Murrayville Road at the left edge (middle) of the map. If there are any homes on that road in the floodplain, are some at greater risk than others?
 - A. The road runs through Zones C unshaded, B and A. The homes in Zone A in the 100-year floodplain are at high risk; those in Zone B, the 500-year floodplain, are at medium risk. In Zone C unshaded, outside the 500-year floodplain, the risk is indeterminate because the map does not show land contours. You can assess the risk only after visiting the property.
19. Find location 1 on the map. What is its hazard?
 - A. It's in Zone B, the 500-year floodplain, so its risk is medium.

Unit 2: Identify the Hazards – Continued

20. What about the hazard for location 2

A. It's in Zone A, so has high risk.

21. What is the hazard for location 3, in the upper middle section of the map, in Zone C, far from marked flood zones? Can you safely assume that site is safe from flooding?

A. No, every area faces potential flooding. Also, the map does not show topography; this area could be a plain where water could back up or contain a creek or underground stream. You can assess the risk only after visiting the property.

22. What is the hazard for location 9? Because the surrounding areas are designated Zone A10, EL 11, can you assume location 9 is fairly safe because it is marked Zone C?

A. No, because you do not know exactly how far above the floodplain they are. Everyone is at risk for flooding, so homeowners should buy flood insurance. You can assess the risk only after visiting the property.

23. Location 5

A. Location 5 is in Zone C unshaded. Its risk is the same as for location 3.

24. Location 7

A. Location 7 is in Zone C unshaded. Its risk is the same as for location 3.

25. Location 8

A. Location 8 is in Zone C unshaded. Its risk is the same as for location 3.

26. Location 10

A. Location 8 is in Zone C unshaded. Its risk is the same as for location 3.

27. What effect does the hatching have on the orange section in western Virginia and North Carolina?

A. The map does not indicate what additional risk is added. Because the section is orange, you might assume the risk level is medium high, with additional information about the specific kind of risk noted.

28. What is the wind risk in Tulsa, OK?

A. Red indicates high risk.

29. What is the wind risk in Kansas City, MO?

A. Red indicates high risk.

30. What is the wind risk in Oakland, CA?

A. White indicates low risk.

31. What is the wind risk in Wilmington, NC?

A. Orange indicates medium risk, and it is in a hurricane-susceptible region.

Unit 2: Identify the Hazards – Continued

32. What is the earthquake risk in Tulsa, OK?

A. Blue indicates low risk.

33. What is the earthquake risk in Kansas City, MO?

A. White indicates low risk.

34. What is the earthquake risk in Oakland/San Francisco, CA?

A. Red indicates high risk.

35. What is the earthquake risk in Wilmington, NC?

A. It seems to be medium because the color is green, but it could be low because the blue is very near.

36. What is the fire risk in Tulsa?

A. Medium (8 months)

37. What is the fire risk in Kansas City, MO?

A. Medium (5 months)

38. What is the fire risk in Oakland/San Francisco, CA?

A. Low (2 months)

39. What is the fire risk in Wilmington, NC?

A. Medium (9 months are colored, but two are yellow, so the tally is 8)

Unit 3: Recognize the Risks and Mitigation Measures

Answers for the exercises are included in the unit.

Unit 4: Integrate Cost Information and the WAP

1. Which risks are highest for **Tulsa**?

A. Wind and fire (The Relative Risk Levels Table shows Tulsa has high risk for wind and medium for fire, but low for flood and earthquake.)

On your Action Checklist for the hazards you checked:

2. What would be the total cost to implement all those measures? Include any donated services/materials available.

A. Answers will vary.

3. Does the total cost exceed your budget?

A. Answers will vary.

4. Which risks are highest for **Kansas City**?

A. Flood and wind (The Relative Risk Levels Table shows Kansas City has high risk for flood and wind, but low for earthquake and medium for fire.)

On your Action Checklist for the hazards you checked:

5. What would be the total cost to implement all those measures? Include any donated services/materials available.

A. Answers will vary.

6. Does the total cost exceed your budget?

A. Answers will vary.

7. Which risks are highest for **SF/Oakland**?

A. Earthquake (The Relative Risk Levels Table shows SF/Oakland has high risk for earthquake, but low for flood, wind and fire.)

On your Action Checklist for the hazards you checked:

8. What would be the total cost to implement all those measures?

A. Answers will vary.

9. Does the total cost exceed your budget?

A. Answers will vary.

10. How will you determine where to concentrate your recommendation when the relative risk rankings are very similar?

A. Look for the most effective benefits, using the criteria to protect first against risk to life and then to property. For property, emphasize enhancing the building integrity of the home, except for fire, when you need to emphasize keeping fire away from the home.

Unit 4: Integrate Cost Information and the WAP – Continued

On your Action Checklist for all four hazards:

11. What is the total cost to implement all your recommended measures?

A. Answers will vary. Choosing any mitigation measures that you checked on your Unit 3 Action Checklist is correct.

12. Does the total cost exceed your budget?

A. Answers may vary.

Final Exercise

13. What mitigation measures will you recommend for this home? (In Wilmington, NC)

A. Because flood has the only “high” rating, recommendations should focus on that hazard.

14. Why?

A. Answers may vary, but the recommendations must be:

- Among the flood mitigation measures checked on the Action Checklist from Unit 3
- Adhere to budget guidelines
- Maximize the programs’ effectiveness to benefit homeowners

Appendix E : Instructor Information

Target Audience

The target audience for this FEMA training is the State Energy Monitors. The State is responsible for the rollout to the CAGs in conjunction with the existing Weatherization Assistance Program (WAP) course.

Course Duration

The course content requires about six and a half-hours if all four hazards are included. Breaks and lunch are in addition. Explanation of time shown in left column.

Class Size

There will be a maximum of 20 students per class to encourage maximum participation and discussion with practice and feedback.

Instructor/Facilitator Qualifications

Instructors must be knowledgeable about various kinds of risks to homes posed by flood, wind, earthquake and fire as well as appropriate mitigation measures for those risks and be skilled facilitators. They should also know how to determine the relative risks for each of the targeted natural hazards and be able to identify potential hazards and appropriate mitigation measures. During training, monitors need to tell the CAG inspectors the base flood elevations of the properties they will be inspecting.

Before delivering training to the CAG inspectors, monitors need to find out various kinds of information, such as what kinds of hazards may be present for the locality and homes to be inspected, what building codes apply, and what permits are needed (if any). See below for a complete checklist of the applicable issues and required information.

Course Structure/Strategy

The course uses a facilitator to lead participants through skills such as how to determine the relative threats from flood, wind, earthquake and wildfire for their local area. Although the course content includes four major hazards, State Energy Monitors training CAGs may omit sections according to local needs.

Participants will learn to read a Flood Insurance Rate Map (FIRM) and use maps illustrating risks from wind, earthquakes and fire as well as use the Action Checklist, which may be a job-aid during and after inspections.

Interactive discussions and exercises will challenge participants to identify hazards and appropriate mitigation measures for protecting life, enhancing safety and reducing potential damage to a home. The practice exercises use visuals that show conditions

participants may encounter during inspections. Participants are encouraged to use their existing knowledge, common sense and initiative.

Learning assessments verify that Inspectors are able to identify the relative risks of natural hazard events and recognize the risks they pose to a home. There are also assessments of participants' abilities to calculate the costs of appropriate mitigation measures, assess how to integrate the WAP and other possible resources, and how to maximize the effectiveness of the program for the homeowner. Unit and cumulative reviews reinforce the content.

Course Materials

Course materials include:

- The *Hazard Identification and Mitigation Training Manual*
- The Action Checklist
- The National Cost Codes Handout
- Guide to Flood Maps, FEMA 258/May 1995
- Flood Rate Insurance Maps (FIRM) for this locality – one for each participant and facilitator
- Detailed earthquake zone map for this locality, as needed
- 1 Easel and pad
- Magic markers
- Pens
- Highlighters
- Name Tags and Name Tents for each participant and facilitator
- Tables/chairs

Issues for Instructor to resolve before training:

1. What kinds of hazards threaten the locality and homes to be inspected, and their relative risks
2. What building codes apply, and what permits are needed (if any)
3. Estimated local costs for implementing the proposed mitigation measures
4. The minimum standards for materials for work being recommended (Inspectors' recommendations must be for mitigation, not beautification.)
5. What monies are available from various sources to fund the mitigation measures, especially donations of money and/or materials? What, if any, limitations are there on their use?
6. Is there an expected average amount an Inspector can spend on mitigation measures for each home? If so, what are the guidelines from the WAP Administrator?

7. How much leeway does an Inspector have to exceed that expected average, by what amount(s), and what substantiation/justification is required?
8. Should Inspectors recommend mitigation measures for houses in the floodplain/coastal barrier areas, or will they be excluded? If they are included, will they have special treatment, such as more/less funding, only funding for flood mitigation measures, or something else?
9. Will money be used for mitigation measures to a home if its risk from a potential disaster is only medium or low when many other homes in the area have only high risk, and all the available money could be spent on those high risk homes?
10. Will the emphasis be on meeting the needs/doing something for every resident whose home is inspected or doing more for the homes at greatest risk?
11. Talking to the homeowner:
 - How much information about the recommendations should the Inspector provide?
 - How much additional information to provide about the NFIP, such as the current cost of premiums in your locality

Specific Data:

- Base flood elevations of the homes Inspectors will be assessing
- Local building codes and required permits
- Local costs of materials and labor

Appendix F : Flood Insurance Documentation

National Flood Insurance Program Fact Sheet

National Flood Insurance Program Website Cost Information

Flood Insurance Slide Show

Flood Insurance Rate Maps

FEMA Guide to Flood Insurance Rate Map

The National Flood Insurance Program (NFIP)

The National Flood Insurance Program is a federal plan which enables property owners in participating communities to buy affordable insurance protection against losses from flooding. Its benefits include putting you in control of managing your risks and greatly speeding your recovery after a flood. Even after floodproofing your home, you still need insurance to protect you from unexpected events like a flood rising higher than your protected level. Homeowners' policies do not cover flood damage, so you need to purchase a separate policy under the **National Flood Insurance Program (NFIP)**. NFIP covers almost all kinds of homes, including a manufactured home affixed to a permanent site and properly anchored.

Although an NFIP policy does NOT cover all kinds of damage, it does cover:

- ✓ Damage to your home and/or its contents caused by surface water flooding (up to the amount of your coverage)
- ✓ Costs for moving and storing your belongings for up to 45 days (up to the amount of the minimum deductible)
- ✓ Expenses for removing debris left by the flood

Types of coverage include:

- Building coverage. You can buy insurance which covers your home's structure (walls, floors), insulation, wall-to-wall carpeting, furnace, and other items permanently attached to its structure. ("Permanent" means anything that would not fall out if you turned the building upside down.) Up to 10 percent of your policy's value for building coverage may apply to a detached garage or carport on the same lot.

Damage to the basement foundation is a major problem, so this coverage can be very important, although it does not cover the finished portions (rugs, furniture, wallpaper, etc.) of a basement. Some private companies sell coverage for water damage caused by sewer backup or sump pump failure, which NFIP does not cover.

- Contents Coverage. This insures your personal property, including clothes washers and dryers, food freezers, and the food in them. It is available to renters as well as owners, even if your home is not insured under the NFIP. It pays some costs to move and store contents in a safe place when a flood threatens.

NFIP flood insurance is sold through private insurance agents and companies. All policies offer identical coverage and rates. A few private insurance companies sell their own flood insurance policies. Their coverage and rates vary and are different from the NFIP's. Some manufactured home insurance covers flood losses.

For information about flood insurance and the NFIP, you may

- call 1-800-427-4661 to find out if your community is participating in the NFIP
- visit FEMA's web site www.fema.gov/nfip
- call the NFIP's toll-free number, 1-888-call-flood, ext. 445, to get the name of a local agent
- call your insurance agent about coverage and rates. Ask if you are eligible for a Preferred Risk Policy, which has especially low premiums. Be sure to get clear answers about exactly what the policy includes and excludes so you can be sure you have appropriate coverage. For example, is damage from rain blown in through a broken window or door covered?

The National Flood Insurance Program (NFIP)

Some Myths and Facts About Flood Insurance and the National Flood Insurance Program

Myth: Federal disaster aid, available during and after a flood, will reimburse me for losses. Therefore, I don't need to buy flood insurance for my home and belongings.

FACT: Federal Emergency Management Agency disaster aid is available only during Presidentially declared disasters, which are less than 50 % of flooding incidents.

Myth: There is almost no chance my house will be flooded.

FACT: Everyone has some a flood risk. In the last few years, floods have hit homes in all 50 states. Floods are caused by storms, melting snow, hurricanes and water backup due to inadequate or overloaded drainage systems, dam or levee failure, etc.

Myth: Only residents of high-flood-risk zones need to insure their property.

FACT: Up to 25% of the NFIP's claims come from outside high flood-risk areas. The NFIP's Preferred Risk Policy, available at a very low rate, is designed for residential properties located in low to moderate-flood-risk zones.

Myth: I can't buy flood insurance because my home was flooded previously.

FACT: If your community is participating in the NFIP, it doesn't matter that your home has been flooded before. You may still buy flood insurance.

Myth: I can't buy flood insurance if my home is located in a high-flood-risk area.

FACT: The Program was created in 1968 to provide flood insurance to people living in areas with the greatest risk of flooding.

Myth: Flood insurance is very expensive and not worth the cost.

FACT: You could lose everything in a flood. If the flood is part of a Presidentially declared disaster, you may receive a grant. Flood insurance always reimburses you for all covered losses, whether or not a disaster is declared. Claims are handled quickly to speed your recovery. You may request a partial payment immediately so you can start recovering faster.

Myth: If a flood is predicted in the near future, it's too late for me to purchase insurance.

FACT: In a participating community, you can purchase flood insurance anytime. However, before the policy is in effect, there is a 30-day waiting period after you have applied and paid the premium. The policy will not, however, cover a loss in progress.

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

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Cost Information

The average cost for an annual flood insurance policy, as of April 30, 2000, is \$353. This average was derived from the number of policies in force by the amount of written premium. The average amount of flood insurance coverage purchased, as of April 30, 2000, is \$124,089.

Depending on where you live and the coverage you choose, flood insurance can cost just a little over \$100 a year through the [Preferred Risk Policy](#).

There are a number of factors are considered in determining the premium for flood insurance coverage. They include:

- ◆ amount of coverage purchased
- ◆ location
- ◆ age of the building
- ◆ building occupancy
- ◆ design of the building
- ◆ for buildings in Special Flood Hazard Areas, elevation of the building.
- ◆ buildings eligible for special low-cost coverage at a pre-determined, reduced premium rate are single-family and 1-4 family dwellings located in zones B, C, & X. Ask your insurance agent if you're eligible for a Preferred Risk Policy.

[Cost & Coverage](#)[Cost Comparision for \\$50,000 coverage](#)[Premium Examples for a \\$100,000 home](#)[Preferred Risk Policy Premiums](#)

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Cost and Coverage Data as of May 1, 2000

Occupancy Type	Regular Program	
	Coverage	Premium*
Single family	\$124,300	\$570
Two to four family	\$101,700	\$524
Other residential	\$85,900	\$665
Non-residential	\$218,600	\$1,514

** Premium values are based on Pre-FIRM Special Flood Hazard Area rates and includes Federal Policy Fee & Expense Constant. Premium does not include ICC premium.*

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A \$50,000 Flood Damage Repair Cost Comparison

With Flood Insurance

\$100,000 Coverage

\$50,000
Flood Damage

— \$1,000 Deductible

\$49,000 Total
Claim Benefit

— \$352 Average
Annual Premium

\$48,648
Net Benefit

\$352
Per Year



As of January 31, 2000,
the average premium for all
policies in force is \$352. Average
coverage is \$123,643. Flood insurance
premiums can be as low as \$106, based on
your flood risk and the coverage you choose.

Without Flood Insurance

\$0 Coverage

\$50,000
Flood Damage

+ \$3,732 Annual
Disaster Loan
Payment

Or

\$311 Per Month
(\$50,000 SBA Loan @
4% interest for 20 yrs)

\$3,732 Net Cost

\$3,732
Per Year

Updated: May 25, 2000

Federal Emergency Management Agency



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Premium Examples For A \$100,000 Single Family Home

If you own a home in a community that participates in the National Flood Insurance Program, you are eligible for flood insurance. More than 19,000 communities participate, so its likely that your community does participate.

There are many factors that affect the price you'll pay for flood insurance. The higher your flood risk, the higher the premium. If you purchase \$100,000 in building coverage for your home, your annual premium will vary depending on the area in which you live.

- If the property is located near the ocean and therefore subject to storm surge and hurricane damage, your building is most likely in a V Zone. Premiums in V zones can be more than \$1,000 annually because your home is in the highest risk area.
- If the property is located near a river, lake or stream, your building is probably in an A zone. Premiums in A zones can be about \$595 annually because of the high potential for flooding.
- If the property is located in a low-risk area, referred to as B, C, X or A99 zones, your premium could be as low as \$306 annually using standard rates. You may also be able to get the Preferred Risk Policy. [Click here for premium rates for the PRP.](#)

Below are annual premiums for \$100,000 of flood insurance coverage for a residential single family home:

Pre or Post-FIRM	Zone	Other Rating Factors	Premium
Pre-FIRM***	Zone V1-30,VE	No Enclosure	\$845.00****
		With Enclosure	\$1,090.00
Post-FIRM***	Zone V1-30,VE	At BFE*	\$ 850.00
	Built between 1975-1981	1 Foot below BFE	\$ 2,180.00
Pre-FIRM	Zone A1-30, AE	No Basement	\$ 595.00

		With Basement	\$ 700.00
Post-FIRM	Zone A1-30, AE	At BFE	\$ 431.00
		1 Foot above BFE	\$ 301.00
		1 Foot below BFE	\$ 1,251.00
Pre-FIRM	Zone AO, AH	With Certification**	\$ 201.00
		Without Certification	\$ 585.00
Pre/Post-FIRM	Zone B, C, X, A99	No Basement	\$ 351.00
		With Basement	\$ 441.00

**BFE-Base Flood Elevation found on Flood Insurance Rate Map*

***Certification is determined by an Elevation Certificate completed by a licensed engineer, surveyor or architect*

****Pre/Post FIRM is determined by the date of the initial Flood Insurance Rate Map*

*****Premium values are based on total written premium plus Expense Constant, Federal Policy Fee and Increased Cost of Compliance premium. Effective date: May 1, 2000*

Updated: July 6, 2000

Federal Emergency Management Agency


 NFIP

NATIONAL FLOOD INSURANCE PROGRAM

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Preferred Risk Policy Premiums

If your single family home is located in a low-risk area, which is a B, C, or X zone on the current flood insurance rate map for your area, you may be eligible for the Preferred Risk Policy. This policy covers both your home and contents with one premium, which can be as little as \$106 a year.

Preferred Risk Premiums

Building with a Basement

Coverage Amount	Contents	Premium
\$ 20,000	\$ 5,000	\$131
\$ 30,000	\$ 8,000	\$156
\$ 50,000	\$12,000	\$196
\$ 75,000	\$18,000	\$221
\$100,000	\$25,000	\$246
\$125,000	\$30,000	\$261
\$150,000	\$38,000	\$276
\$200,000	\$50,000	\$306
\$250,000	\$60,000	\$326

Building without a Basement

Coverage Amount	Contents	Premium
\$ 20,000	\$ 5,000	\$106
\$ 30,000	\$ 8,000	\$131
\$ 50,000	\$12,000	\$171
\$ 75,000	\$18,000	\$196
\$100,000	\$25,000	\$221
\$125,000	\$30,000	\$236
\$150,000	\$38,000	\$251
\$200,000	\$50,000	\$281
\$250,000	\$60,000	\$301

Building deductible \$500 and Contents deductible \$500 applied separately. Premium includes Federal Policy Fee and Increased Cost of Compliance premium. Effective date: June 1, 1998

Preferred Risk Policies (PRP) are only available for owners of 1-4 family residential buildings. Additionally should any of the following conditions apply to your home, based on its flood history regardless of ownership, a PRP cannot be written: *

- 2 loss payments, each more than \$1,000
- 3 or more loss payments, regardless of amount
- 2 Federal Disaster Relief payments, each more than \$1,000
- 3 Federal Disaster Relief payments, regardless of amount
- 1 flood insurance claim payment and 1 flood disaster relief payment (including loans and grants), each more than \$1,000

If your home is in a low-risk area, and one or more of the above conditions apply or you own a building other than a 1-4 family home that is located in a

B, C, or X zone, you can still purchase flood insurance at the low-risk Standard Rates. [Premium examples for \\$100,000 of coverage for a single-family home.](#)

*Contact your insurance agent for all the eligibility requirements for a PRP.

Updated: July 24, 2000

Federal Emergency Management Agency



Federal Emergency Management Agency (FEMA)



NATIONAL FLOOD INSURANCE PROGRAM

MIRACLE PAINKILLING POWER OF COPPER JEWELRY

Beat arthritis & other agony forever!



Sun

\$1.29/\$1.39 CANADA April 8, 1997



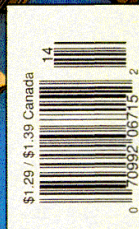
**As Bible predicts:
The Hale-Bopp
comet will trigger**

NEW FLOODS MENACE

WORST IS YET TO COME

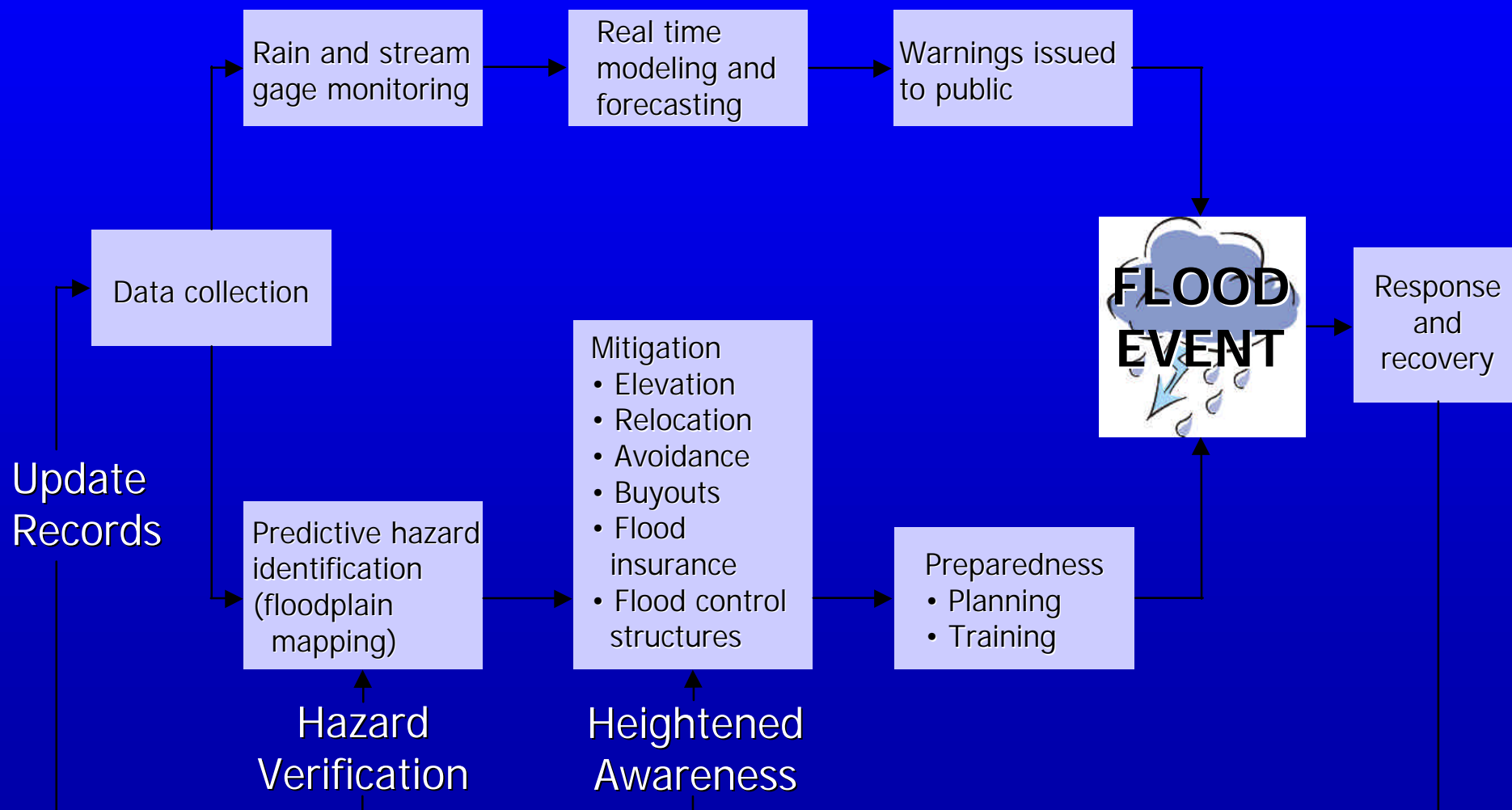


**Thousands
to die in
low-lying
areas from
century's
stormiest spring & summer**





Flood Disaster Cycle





NFIP Overview

Purposes:

- Make flood insurance available
- Identify floodplain areas and flood risk zones
- Provide framework for floodplain management regulations





Federal Emergency Management Agency (FEMA)

- Builds and supports U.S. emergency management system
- Coordinates the Federal Response Plan
- Administers the National Flood Insurance Program (NFIP)
- Coordinates preparedness, training, exercises at Federal, State, and local levels
- Administers the Public Assistance Program
- Encourages mitigation through:
 - NFIP
 - ***Project Impact***
 - Community Rating System
 - Hazard Mitigation Grant Program



FEMA's Flood Mapping Program

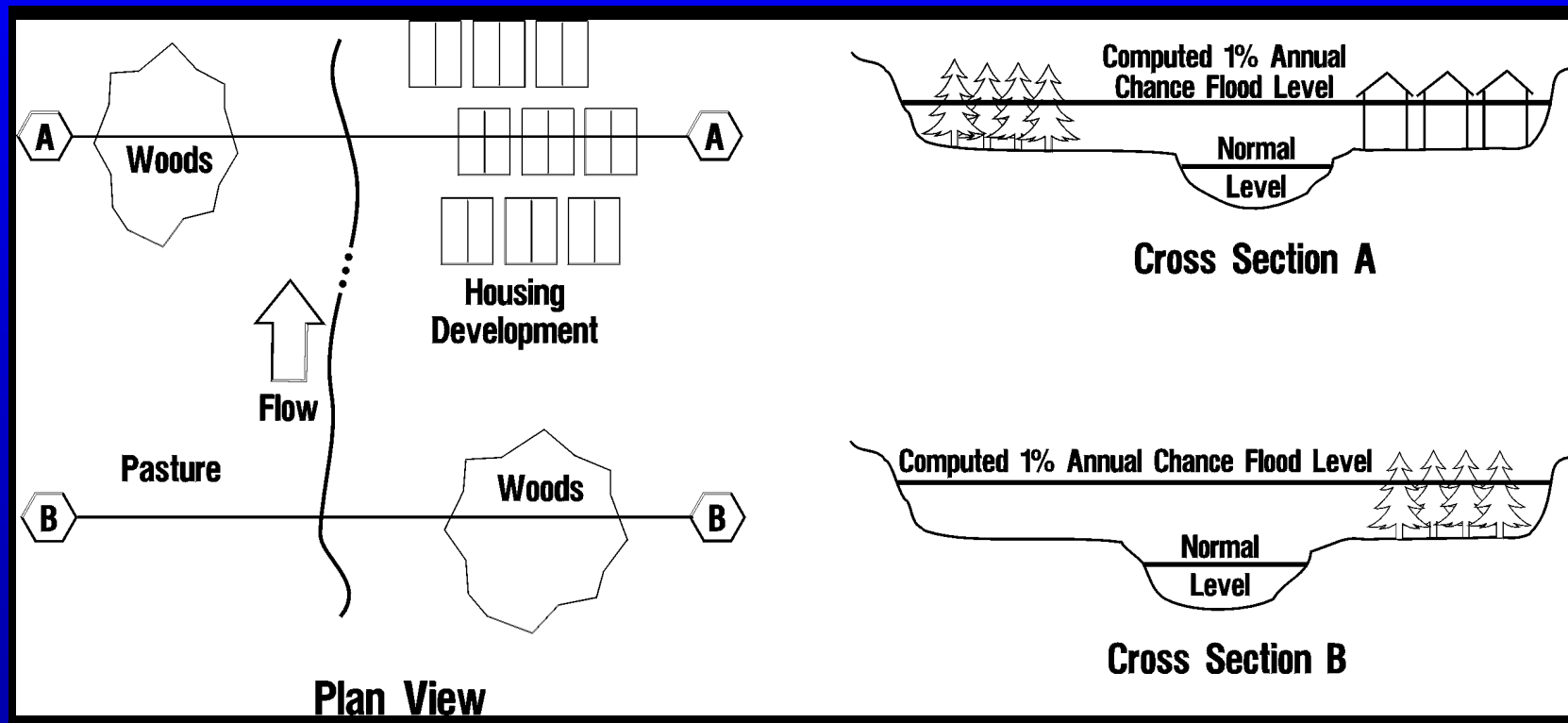
Special Flood Hazard Area (SFHA)

The area that has a 1%, or greater, chance of being inundated in any given year



Components of Flood Insurance Study

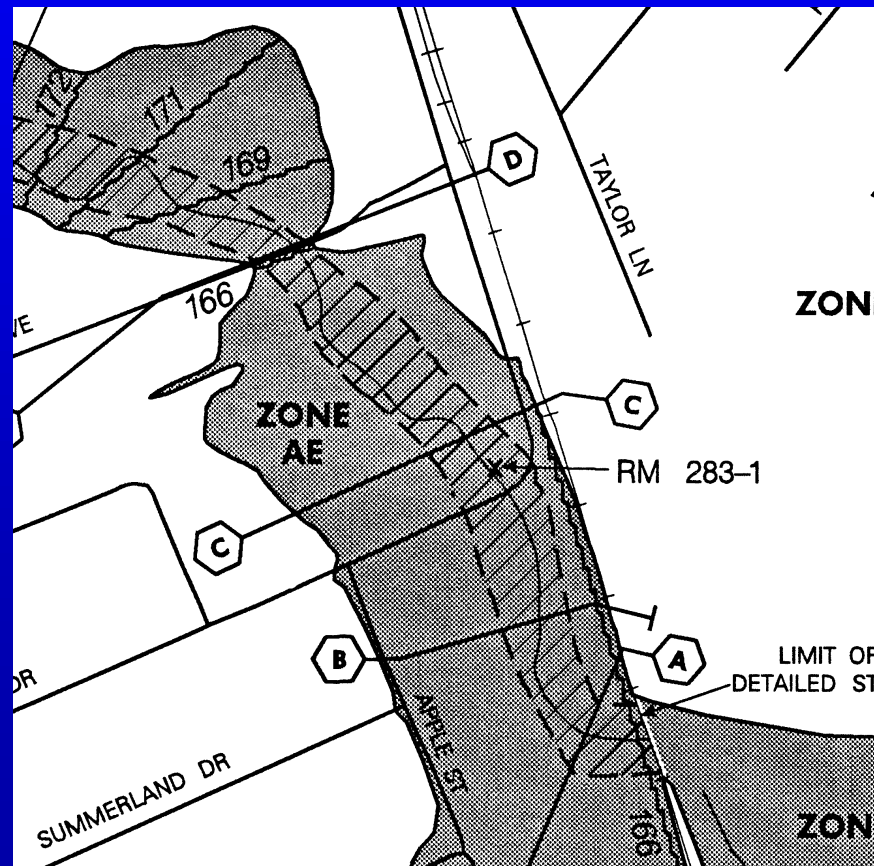
Hydraulic Analyses





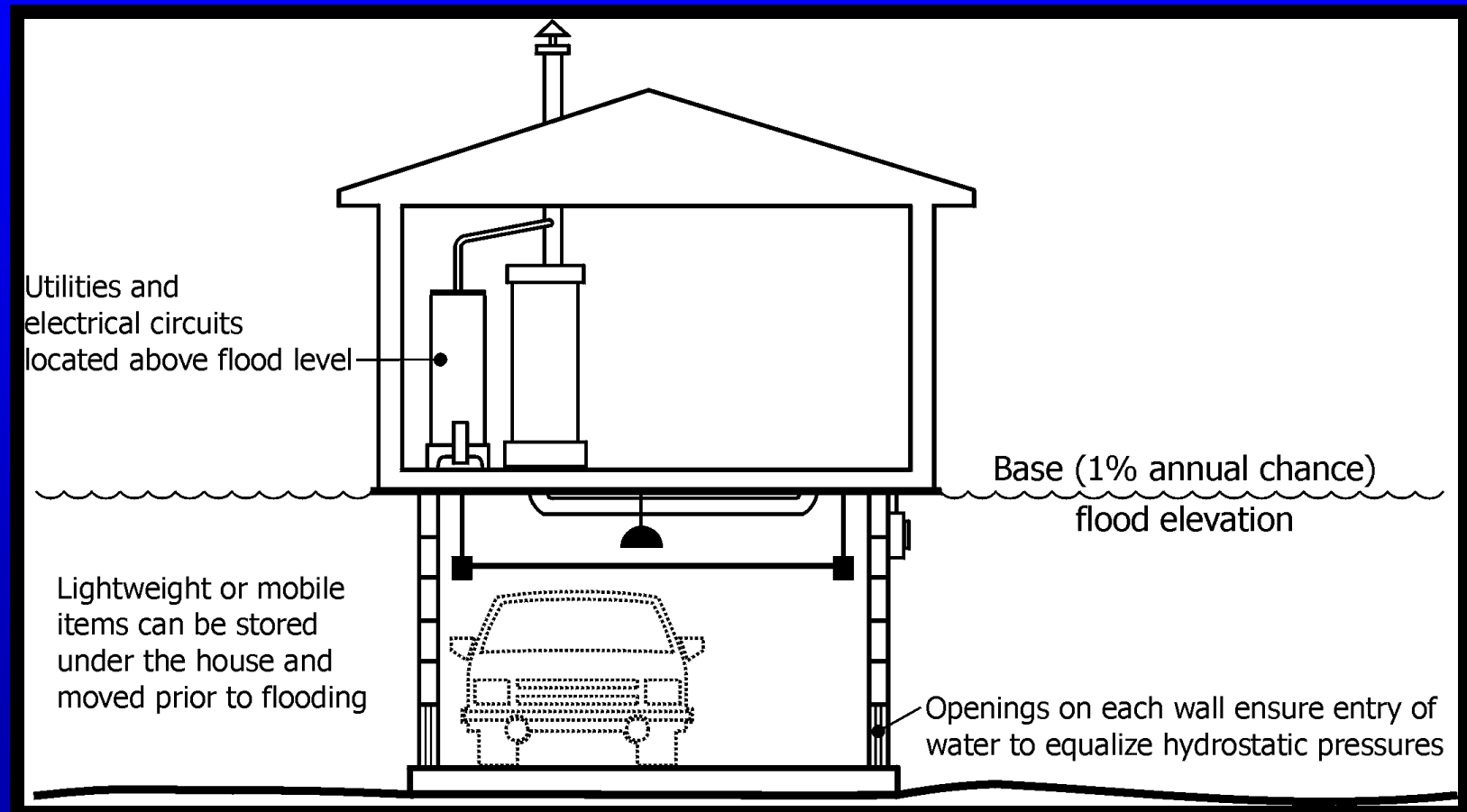
NFIP Overview

- Identify floodplain areas and flood risk zones
 - Over 100,000 map panels for approximately 20,000 communities
 - Over 100 million acres of floodplain mapped
 - Approximately 6 million acres of floodway along 40,000 stream/river miles





NFIP Overview



Elevation requirements for residential structures





Project Impact

Building Disaster Resistant Communities

- FEMA's top priority
- Designed to break the disaster-rebuild-disaster cycle
- Helps communities become disaster resistant through:
 - Mitigation
 - Planning
 - Partnership building
- Emphasizes private sector involvement



Appendix G : Case Studies

Case Study 1 – Manufactured Home

Case Study 2 – Single Family Home

Case Study 1 – Manufactured Home

Unit Type: Single-Wide Manufactured Home
Client Address: Wilmington, New Hanover County, NC



Introduction to the Case Study

A young couple with one child who own and reside in the home filed an application for the Weatherization Assistance Program (WAP). After the application was approved, a Weatherization Inspector visiting the home in February 2000 performed a series of inspections which focused on opportunities for both weatherization and hazard mitigation. This Case Study documents the inspections, the identification of opportunities for improvement and final recommendations. It illustrates the integration of the weatherization and hazard mitigation inspections and the decision making process used by an Inspector after receiving Hazard Identification & Mitigation (HI&M) training.

Description of the Home

The client lives in a 1966 single-wide manufactured home consisting of a living room/kitchen combination, two bedrooms and one bath. It is located in a dedicated mobile home park with water, sewer and electrical underground utility hook-ups. A paved road provides access to the home and the park includes trees and vegetation. There is a system of drainage ditches to channel stormwater away from the homes.



Identification of Weatherization Opportunities

On arriving at the home, the Inspector introduced himself to the clients and made sure they were aware of the purpose and goals of the WAP. Then he performed a simple review of the exterior and interior of the structure as a whole to ensure that the home conformed to program guidelines. The review included sketches and measurement of the home's layout. The unit was found to be structurally sound, so investment of funds to make the home more energy efficient was justified.

The Inspector then used a standard blower door test to evaluate the "air tightness" of the home. The test is designed to indicate if the home has air leaks that allow heat to escape and make the home less energy efficient. The home scored as follows:

Current Blower Door Reading:	2,800 cfm
Desired Blower Door:	1,500 cfm

The blower door test results indicated the home had considerable air leakage. Leakage was found around the front door frame, where the original door had been replaced and around the second door that was improperly sized in a poorly fitted frame.

Broken and missing windows in the home also made a significant contribution to the poor blower door readings.



The Inspector then examined the furnace and interior heating systems. The furnace was located in a central cupboard, was improperly installed and not in working condition. There was considerable air leakage around the unit, as well as leakage through an unsealed flue from the original furnace. The heating ductwork was also in extremely poor condition. Many of the vents were rusted through, and the clients had taped cardboard over them to try to reduce the cold airflow. It was determined that these ducts could not be used.

After completing the blower door test and furnace inspection, the Inspector decided that there were opportunities to use WAP funds to improve the energy efficiency of the home. Weatherization measures to stop air infiltration included the installation of doors and windows, and applying caulking, roof cement and



mobile home coating.

The Inspector then estimated the types and quantities of materials required to complete the Weatherization improvements to the home.

Weatherization Materials Listing:

- 1 Diamond Door
- 2 2x4x8 Treated Lumber
- 1 ¾" Plywood
- 12 Mobile Home Windows
- 15 Caulking Tubes
- 1 Gallon of Roof Cement
- 48" Door Casing
- 1 Pound of #6 Finishing Nails
- 2 5-Gallon Containers of Mobile Home Coating
- 8 Putty Tape Rolls
- 13 Boxes of Screws

Estimated Material Cost: \$761

Estimated Labor Cost: \$761 (1:1 materials to labor multiplier)



Heating Appliance Repair and Replacement Program (HARRP)

Measures:

The client currently uses electric space heaters as their only heat source because the furnace is inoperable. The inefficiency of the space heaters, combined with the high air leakage, have led to extremely high monthly utility bills. Therefore, the Inspector recommended that the client receive a gas monitor space heater that will provide adequate, safe heating for the family.

Projected Cost: \$1,500.00 (Current CO Reading: 0 ppm)

Hazard Identification and Mitigation Measures:

Before going to inspect the home, the Weatherization Inspector determined the relative risk of flood, fire, wind and earthquake for the home. The Inspector found that the region of New Hanover County, NC is at some risk from all four hazards.



Flood - The Flood Insurance Rate Map showed that the home is in an unshaded Zone C, an area outside the 500 year floodplain. The Inspector noted that because the home dated from 1966, before current FEMA standards were established, the consequences of flooding might be severe. He also noted that the area is susceptible to localized flooding from hurricanes. The FIRM suggested a low risk of flooding from riverine or coastal flooding, and the Inspector decided to check the localized chance of flooding during the inspection.



Wind – The Wind Zones in the US map clearly shows New Hanover County to be in the orange, Zone III region. It also showed the Inspector that the area is subject to hurricanes. The Inspector decided that this hazard posed a major threat and assessed the risk at medium high.



Earthquake – The National Map of Earthquake Zones suggests that New Hanover County is in a moderate risk area. Deciding to investigate this further, the Inspector reviewed the more detailed map of North Carolina. It showed that the most of New Hanover County was in the blue or low medium risk area.



Fire – The Inspector then consulted the Map of Fire Risk. By examining the fire risk on a monthly basis, the Inspector determined that New Hanover County has a fire score of 7 which makes it at moderate risk for fire.

In summary, before the Inspector had even visited the site, the relative risks from these four natural hazards had been assessed and prioritized as wind, fire, earthquake and flood. During training, the Inspector had also been informed of additional programs and resources to maximize the benefits to the client.

As the Inspector approached the property to perform his initial assessment for conformity to weatherization program guidelines, he noticed the grading around the home. The land is flat and may be susceptible to flooding from heavy hurricane rainfall. The Inspector observed a large stormwater ditch behind the home that was generally clear of obstructions, so he was satisfied that the home had a low risk of flooding. Also, as in most manufactured homes, the base of the unit was installed two feet above ground level.

After introducing himself to the clients, the Inspector performed an exterior evaluation of the home. The inspection included drawing a plan of the structure and identifying window sizes and styles. This time was the perfect opportunity to review the exterior of the home for hazard mitigation





opportunities. The review focused on the higher risk wind hazard and included checking whether the mobile home was properly strapped and anchored. The home had standard “over the top” style straps, but a number of them were not adequately secured and were loose when pulled by hand.

The Inspector looked under the home to inspect the anchoring of the straps to the frame of the home and to the ground. The anchoring was adequate and used standard ground anchors that were appropriate for the conditions expected.

The exterior surface sheathing of the home was noted as being in fair condition. The doors and windows were noted as poor from a hazard mitigation perspective but would probably be replaced as part of the WAP. Most of the property was free and clear of debris. During the weatherization process excess building materials and debris would be removed from the property, in order to further reduce the potential for windborne debris.

When the Inspector moved to the interior of the home and performed the standard blower door test, he walked through the mobile home looking for air leaks. During this process he also assessed the interior of the home for potential hazards. Although earthquake was a low medium risk, he noted that the interior did not include many overhead cupboards, free standing furniture or other heavy elements that could break free or topple during an earthquake.

The Inspector did notice, however, that there were no operating smoke or carbon monoxide detectors in the home. Although the risk of fire outside the home was reduced by a noticeable gap or fire break between homes and a lack of debris, the interior was at risk. The Inspector made a note to install smoke and carbon monoxide alarms, hard-wired with battery back-up.





While performing a review of the furnace and interior heating systems, the Inspector observed the poor furnace installation. As part of the HARRP program the Inspector recommended installing a gas-fueled heating system that would include gas tanks outside the home. Although this potential hazard was not present at the inspection, the Inspector saw a potential for leveraging his funds from HARRP, WAP and HI&M. The Inspector recommended that while the certified gas installer was putting the heating system in place that he also install

a gas safety cut-off valve on the fuel line. The cut-off valve would reduce the risk of gas leakage if there were a break from wind, flood or earthquake. In addition, the gas tanks themselves should be elevated and strapped.

After concluding the inspection, the Inspector estimated the types and quantities of materials required to complete the Hazard Mitigation improvements to the home.

Hazard Mitigation Materials Listing:

- 2 Smoke & Carbon Monoxide alarms
- 1 Gas Safety Cut-Off Valve
- 4 2x4x8 Treated Lumber – for raising the gas tanks & interior furnace
- 2 1x4x10 Treated Lumber – for bracing the gas tanks & interior furnace
- 1 ¾” Plywood– for raising the gas tanks & interior furnace
- 1 Reattachment of Anchoring Straps



Estimated Material Cost: \$300

Estimated Labor Cost: \$300 (1:1 materials to labor multiplier)

The Inspector successfully integrated the WAP and HI&M inspections and recommendations. He used HI&M training to evaluate the relative risks of the hazards and match them against conditions at the property. The Inspector made recommendations of mitigation measures to directly reduce the particular risks at the home and combine program resources to maximize the benefits for the client.

Case Study 2 – Single Family Home

Unit Type: Single Family, Wood-Frame Home

Client Address: Wilmington, New Hanover County, NC



Introduction to the Case Study

An elderly homeowner filed an application for the Weatherization Assistance Program (WAP). After it was approved, a Weatherization Inspector visiting the home in February 2000 performed a series of inspections which focused on opportunities for both weatherization and hazard mitigation. This Case Study documents the inspections, the identification of opportunities for improvement and final recommendations. In particular, the Study illustrates the integration of the weatherization and hazard mitigation inspections and the decision-making process an Inspector uses after receiving Hazard Identification & Mitigation (HI&M) training.

Description of the Home

The client's home is a small, wood-frame unit consisting of four rooms and one bathroom. Four people reside in this home including an elderly person and children. The home is located near a main highway and access to is provided along 800 yards of poorly maintained dirt road. There are telephone and electricity hook-ups, but water comes from a well on the property. Sewage goes to a drain field. The area around the home is heavily wooded with light vegetation at grade level adjacent to the home.

Identification of Weatherization Opportunities

On arriving at the home, the Inspector introduced himself to the client and made sure she was aware of the purpose and goals of the WAP. Then he performed a basic review of the exterior and interior of the overall structure to ensure that the home conformed to program guidelines. The review included sketches and measurement of the home's layout. The unit was found to be structurally sound, except for a portion of the roof. Most of the roof sheathing consisted of wood boards running the length of the house and was found to be in fair condition. However, in one corner, the fascia board had rotted and part of the eave was missing, and, in another corner, the eave was badly damaged from rot and weathering. There was no insulation, and the missing eave created a large gap between the roof and wall.



The Inspector noted that this portion of the roof needed replacement. Although replacing the damaged portion of the roof would be more than the WAP alone could fund, weatherization by installing insulation would be useless without it. Also, from a risk mitigation standpoint, the Inspector realized that if the eave was not repaired, winds could blow up and into the roof space during a future hurricane. This action could accelerate the roof damage and potentially destroy the entire home. Therefore, it was in the best interests of the homeowner, WAP, and HI&M to repair the roof.



When the Inspector examined the inside of the home, he found that the door to the plastic-enclosed porch area was permanently open, so the energy efficiency of the home was further reduced. The Inspector decided to install doors on the porch and reduce air infiltration. The Inspector also recommended that attic insulation be installed. To help eliminate air infiltration, he further recommended applying minor glazing, caulking, and roof cement. The Inspector estimated the types and quantities of materials required to make the weatherization improvements to the home.



Weatherization Materials Listing:

- 2 6-Panel Doors
- 2 Peep Holes
- 2 Door Lock Combinations
- 3 Pairs of Hinges
- 2 2-Piece Thresholds
- 2 Weather Strip Sets
- 1 2x6x8 Treated Lumber (For eave)

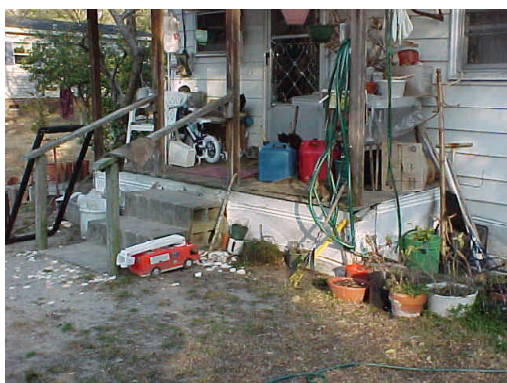




- 15 Caulking Tubes
- 8 Glazing Tubes
- 1 Gallon of Roof Cement
- 1 Foam Tape Roll
- 1 #8 Nails (Pound)
- 1 Storm Door Closure
- 1 Insulation for 20x26 Attic (use R rating appropriate to local codes)

Estimated Material Cost: \$650

Estimated Labor Cost: \$650 (1:1 materials to labor multiplier)



Heating Appliance Repair and Replacement Program (HARRP) Measures:

When the Inspector examined the furnace and interior heating systems, he found the client used unvented kerosene heaters as the sole heat source. The inefficient heaters were expensive to operate and were a safety hazard. Therefore, the Inspector recommended that the client receive a gas space heater to provide adequate, safe heating for the family.



Projected Cost: \$1,200.00
(Current CO Reading: 92 ppm)



Hazard Identification and Mitigation Measures:

Before going to inspect the home, the Weatherization Inspector determined the relative risks of flood, fire, wind, and earthquake to the home. The Inspector found that the region of New Hanover County, NC is at risk from all four hazards.

Flood - The Flood Insurance Rate Map showed that the home is in an unshaded Zone C, an area outside the 500-year floodplain. The Inspector noted that because the home dated from 1966, before current FEMA standards were established, the consequences of flooding might be severe. He also



noted that the area is susceptible to localized flooding from hurricanes. Therefore, although the FIRM suggested a low risk of flooding from riverine or coastal flooding, the Inspector decided to check the chance of localized flooding while he was doing the inspection.



Wind – The Wind Zones on the U.S. map indicates that New Hanover County lies in the orange, Zone III region. It also shows the Inspector that the area is at risk for hurricanes. Taken together with the fact that there are numerous large trees nearby that could fall on the home, the Inspector decided that this hazard posed a significant threat, and so, assessed the risk at medium high.



Earthquake – The National Map of Earthquake Zones suggests that New Hanover County is in a moderate risk area. Upon further investigation, the Inspector reviewed a more detailed seismic map of North Carolina, and concluded that most of New Hanover County was in the blue or low medium risk area.



Fire – The Inspector then consulted the Map of Fire Risk. After calculating the fire risk on a monthly basis, the Inspector determined that New Hanover County has a fire score of 7 which makes it at moderate risk for fire.

In summary, before the Inspector had even visited the site, he had assessed the relative risks of these four natural hazards and prioritized them in order as wind, fire, earthquake, and flood. During training, the Inspector had also been informed of additional programs and resources to maximize the benefits to the client.

As the Inspector approached the client's property to perform his initial assessment for conformity to Weatherization program guidelines, he also noted the grading around the home and the type of soil. Although the terrain is flat and appears to be susceptible to flooding from heavy hurricane rainfall, the soil is very loose and sandy. Conversations with the homeowner confirmed that the area drained very quickly because of the soil characteristics and there had been no flooding in living memory. Therefore, the Inspector was satisfied that flooding was indeed a lower risk for this home.

As mentioned previously, the Inspector first performed an exterior evaluation of the home. The evaluation included drawing a plan of the structure and identifying the window sizes and styles. At the same time, he examined the exterior of the home for hazard mitigation opportunities. Consistent with his focus on the higher risk wind hazard, the Inspector noted the need for roof repairs.

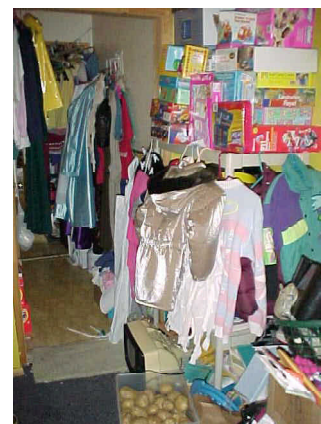
The exterior of the home appeared to be anchored properly to the ground and the side sheathing was in fair condition. The doors and windows were



noted as poor from a wind-risk mitigation perspective but would probably be replaced as part of the WAP. There was little to no debris on the property.

When the Inspector moved to the interior of the home and performed the standard blower door test, he walked through the single family home looking for air leaks. During the test, he also assessed the interior of the home for other potential risks. Although earthquake was a low medium risk, he noted that the interior included many stacked boxes that were at risk of breaking free or toppling during an earthquake.

The Inspector also noted that there were no operating smoke or carbon monoxide detectors in the home. Although the risk of fire outside the home was reduced by a noticeable gap or fire break between homes and a lack of debris, the interior was at risk. The Inspector recommended installing smoke and carbon monoxide detectors, hardwired with a battery back-up.



After examining the furnace and interior heating systems, the Inspector recommended installing a gas-fuelled heating system that would include gas tanks outside the home. Although this potential fire risk was insignificant, the Inspector saw the potential for leveraging his funds from HARRP, WAP, and HI&M. The Inspector recommended that while the certified gas installer was putting the heating system in place that he also install a gas safety cut-off valve on the fuel line. Doing so would reduce the risk of gas leakage if there were an interruption from wind, flood or earthquake. The tanks themselves should be strapped in place at a minimum and also elevated if there are enough funds left.



After concluding the inspection, the Inspector estimated the types and quantities of materials required to complete the Hazard Mitigation improvements to the home.

Hazard Mitigation Materials Listing:

- Replace damaged or missing portion of roof
- Install Smoke and CO Alarms – hardwired with battery back-up
- Install Gas Safety Cut-Off Valve on fuel line
- Elevate and strap gas tanks

Estimated Material Cost: \$900

Estimated Labor Cost: \$900 (1:1 materials to labor multiplier)

The Inspector successfully integrated the WAP and HI&M inspections and recommendations. Without the roof improvements, weatherization would have not been possible. The Inspector made recommendations of mitigation measures to directly reduce the particular risks at this home and combine program resources to maximize the benefits for the client.